SHIPROCK FIRST RESPONDERS SUBSTATION (SFRS)

NAVAJO NATION

SHIPROCK, NM 87420

PROJECT MANUAL

-

100% Construction Documents

Dated: January 28, 2019

Issued: January 29, 2024

DMA PROJECT No. 2018.03

DYRON MURPHY ARCHITECTS, P.C.

SHIPROCK FIRST RESPONDERS SUBSTATION FACILITY
SHIPROCK, NEW MEXICO

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INVITATION TO BID

Navajo Nation Department of Corrections (the "Owner"), invites General Contractors to submit bids for general construction of the Shiprock First Responders Substation Facility, at Shiprock, New Mexico.

The work includes new two-story commercial facility to house EMS, Fire, and Police personnel, large vehicle garage, site improvements, site infrastructure, plumbing, mechanical & electrical work.

The construction contract will be awarded on a lump-sum basis. Procurement is subject to the Navajo Nation Business Preference Law; Title 5, Navajo Tribal Code, Section 201 through 218 and other applicable Navajo Nation Laws. Bids must be in accordance with Bid Documents prepared by the Project Architect, Dyron Murphy Architects, P.C., Albuquerque, NM, (505) 830-0203.

Bids shall be filed with the Owner by the deadline of March 14, 2024 by 2:00 PM MDST at office of the Architect. Bids received after the deadline will not be accepted and returned. No faxed or emailed bids will be accepted.

Bid Documents may be obtained from ALBUQUERQUE REPROGRAPHICS, 4716 McCleod NE, Albuquerque, NM 87109, according to bid retrieval instructions on the ABQ Reprographics website: https://www.arigraphix.com/

Questions shall be addressed in writing to the Architect's office by email, to Dyron V. Murphy, AIA, Principal, at dmurphy@dm-architects.com.

The Owner reserves the right to reject any and all bids, to waive any informalities or irregularities when it is in the best interest of the Owner. Bids are valid for 120 calendar days upon submittal. Navajo Nation is not bound to enter into a contract under this ITB and may issue a subsequent ITB for the same services.

End of Invitation to Bid

INSTRUCTIONS TO BIDDERS

1.0 DEFINITIONS

1.1 **PROJECT**: The Project consists of the construction of a new First Responders Substation Facility, by a Bidder, for a Lump Sum Price agreed to by the most responsive Bidder and the Owner.

1.2 **OWNER:** Navajo Nation (the "Owner"), Window Rock, Arizona

Address: Navajo Nation Department of Corrections Administration
Dr. Delores Greyeyes, Director
Window Rock Unified School District (WRUSD)
Administration Building Corner of N7 & N12
West of TMS-Hospital Housing
PO Box 559-Navajo Route 12
Fort Defiance, AZ 86504
Owner's Representative: Darryl Sam, Owner's Project Manager

1.3 **ARCHITECT/ENGINEER:** Professional firm retained by the Owner to assist in development of the Project whose responsibilities includes:

a. Review of Bids submitted in accordance with Bid Documents.
b. Review of design information submitted by Bidders.
c. Provides recommendations of technical nature to Owner regarding design and construction matters.
d. Issues Bid Documents and makes clarifications, issues addenda, reviews requests for substitutions, and/or receives bids.
e. Issues relevant design data, e.g., drawings or specifications for project.
f. Assists Owner in contract issuance and negotiations with selected successful Bidder.
g. Provides Construction Administration and Observation services on behalf of Owner during construction.
h. Assists Owner during contract closeout procedures.
i. Assists Owner during conferences and meetings prior to receipt of Bids, during contract negotiations, and during construction.
j. Reviews and approves construction submittals.
k. Reviews and approves construction pay requests.

Address: Dyron Murphy Architects, PC
4505 Montbel PL NE
Albuquerque, New Mexico 87107
Telephone: (505) 830-0203
Representative: Dyron V. Murphy, AIA, Principal

1.4 **BIDDER:** A builder, contractor, or developer acting as the primary agent responsible for submitting a bonafide written Bid for a prime contract with the Owner for the Project described in the Proposed Contract Documents. The Bid shall include all required costs, e.g., labor, travel, materials, overhead expense, profit, and related costs to provide

complete construction services associated with the development of the Project. The Bidder shall be responsible for administering all aspects of the work and contract requirements. A representative shall be designated to act on behalf of the Bidder to enter into agreements, provide direction, and adjudicate matters related to construction issues under the contract.

1.5 **BID DOCUMENTS:** General documents which are issued by the Owner and describe the process for executing the Project, include, but are not limited to the following:

CONTRACT DOCUMENTS:

a. Invitation to Bid
b. Instructions to Bidders.
c. Bid Form.
d. Subcontractor List Form.
e. Agreement Forms.
f. Wage Rate Determination.

TECHNICAL PROVISIONS

a. Project Drawings.

1.6 **ADDENDA**: Written or graphic instruments issued by the Architect prior to the submission of Bids which modify or interpret the Bid Documents by additions, deletions, clarifications or corrections.

1.7 **BID**: A complete and properly signed Bid to complete the Project for the Lump Sum Price agreed upon therein, supported by information or forms called for by the Bid and Contract Documents. The Bid shall include the following submittal documents in order to be considered for this contract:

a. Bid Form, signed and sealed, including breakdown in the form of Schedule of Values for each bid price option, by CSI Division that corresponds to the scope of work, and acknowledgement of receipt of Addenda, if applicable.
b. Bid Bond in amount of 10% of Bid entered, including Name and Address of bonding company, and limits of Bonding at time of Bid Submittal.
c. Power of Attorney, if necessary.
d. Evidence of General Construction Licensure for the State of New Mexico, including active dates.
e. Certification from the Navajo Nation Business Regulatory Department, indicating level of Preference, if claimed.
e. Subcontractor's List Form indicating Navajo-owned companies, if applicable.
f. Certificates of General Liability and Workman's Compensation Insurance, indicating coverage amounts, both Aggregate and Per Incident.
g. Affidavit of Non-Collusion, notarized.

2.0 BIDDER'S REPRESENTATION

2.1 Each Bidder by making his/her Bid represents that:

A. He/she has read and understands the Bid Documents and their Bid is made in accordance within.

B. He/she have visited the site and have familiarized him/her with the local conditions under which the Project is to be performed.
C. His/her Bid is based upon the materials, labor, transportation, systems and equipment proposed in his/her interpretations and assumptions described by his/her design submittal as part of his/her Bid, and other pertinent information contained in the Bid Documents.

3.0 BID DOCUMENTS

3.1 Copies: Bidders may obtain sets of the Bid Documents for the deposit sum, and at the location stated in the Invitation to Bid. The deposit will be refunded as stipulated in the Invitation to Bid. A Bidder receiving a contract award may retain the Bid Documents and his/her deposit will be refunded.

A. Information contained in the Bid Documents shall be used by the Bidder in preparation of his/her Bid pricing and construction documents; neither the Owner nor the Architect assumes any responsibility for errors or misinterpretations resulting from the use of incomplete sets of Bid Documents.
C. The Owner or the Architect, in making copies of the Bid Documents available on the above items, do so only for the purpose of obtaining Bids on the Project and do not confer a license or grant for any other use.

3.2 Interpretation or Correction of Bid Documents

A. Bidders shall promptly notify the Architect of any ambiguity, inconsistency or error, which they may discover upon examination of the Bid Documents, or of the site and local conditions.
B. Bidders requiring clarification or interpretation of the Bid Documents shall make a written request to the Architect at least ten (10) calendar days prior to the date for receipt of Bids. Requests for clarification received less than ten (10) days before the date for receipt of Bids will not be addressed by the Owner or Architect.
C. Any interpretation, correction or change of the Bid Documents will be made by Addendum. Interpretations, corrections or changes of Bid Documents made in any other manner will not be binding, and Bidders shall not rely upon such interpretations, corrections or changes.
D. The Bid Documents were previously developed in 2019 under the project name, "*Shiprock Incident Command Center*". All drawing sheets and specifications issued for the Bid may have this designation remaining on the Bid Documents. The Bidder is hereby notified that the Owner changed the name in December, 2023 to "*Shiprock First Responders Substation*", therein, all references from the initiation of this Bid process shall reflect this change in all documentation, communications, and related actions for this project.

3.3 Substitutions

A. The materials, products and equipment described in the Bid Documents establish a standard of required performance, function, dimension, appearance and quality to be met by any proposed substitution. Materials, products, or equipment by other manufacturers and vendors deemed to adequately perform the duties imposed by the general design intent will be considered equally acceptable provided the

material, equipment, or product so proposed is, in the opinion of the Architect, of equal performance and function. The burden of proof of the merit of the proposed substitute is upon the Bidder. The Architect's decision of approval or disapproval, after consultation with the Owner, of a proposed substitution shall be final. No substitution shall be purchased or installed by the Contractor without the Architect's written approval.

B. It shall be the responsibility of the Bidder to provide and pay for all modifications that may be required of other trades, which may add to their costs, brought about by substitutions and/or options after the contract has been let. No additional costs shall be assessed to the Owner.

C. Substitution Bids which deviate from those materials, equipment, or products described in the Bid Documents shall be noted on the drawings or proposed method of construction in the Bidders Bid package.

D. A request for a substitution constitutes a representation that the Bidder:

1. Has investigated the proposed product and determined that it is equal to or superior in all respects to that specified.
2. Will provide the same warranties or bonds for the substitution as for the product specified.
3. Will coordinate the installation of any accepted substitution into the Project and make such other changes as may be required to make the Project complete in other respects.
4. Will not increase the maximum contract price. Where substitutions of materials are deemed acceptable and are of lesser value than the established standards, a cost credit from the Bidder to the Owner shall be applied to the maximum contract price.

3.4 ADDENDA

A. All who are known by the Architect to have received a complete set of Bid Documents will be notified of any Addenda issuance and place of availability for pickup. The Bidder shall provide a working fax number and/or email address where addenda may be transmitted for receipt by the Bidder.

B. Copies of Addenda will be made available for inspection wherever Bid Documents are on file for that purpose.

C. No Addenda will be issued later than four (4) days prior to the date for receipt of Bids except an Addendum, if necessary, postponing the date for receipt of Bids or withdrawing the request for Bids.

D. Each Bidder shall ascertain, prior to submitting his/her Bid, which he/she has received all Addenda issued, and he/she shall acknowledge receipt of all issued Addenda on the Form of Bid.

4.0 BID PROCEDURE

4.1 Form and Style of Bids

A. Bids shall be submitted on the form(s) provided in the Bid Documents.

B. All blanks on the Bid Form shall be filled in by typewriter or legibly in ink.

C. Where so indicated by the makeup of the Bid Form, sums shall be expressed in both words and figures, and in case of discrepancy between the two, the written amount shall govern.
D. Any interlineation, alteration or erasure must be initialed by the signer of the Bid.
E. Bidders shall make no additional stipulations on the Bid Form, nor qualify his/her Bid in any other manner.
F. Each Bid shall include the legal name of the Bidder and a statement whether the Bidder is a sole proprietor, a partnership or a corporation, or any other legal entity and shall be signed by the person or persons legally authorized to bind the Bidder to a contract. A Bid by a corporation shall further list the State of incorporation and have the corporate seal affixed. A Bid submitted by an agent shall have a current Power of Attorney attached certifying the agent's authority to bind Bidder.

4.2 Bid Security

A. Each Bid shall be accompanied by a Bond or Cashier's Check in the required form and amount pledging that the Bidder will enter into a Contract with the Owner on the terms stated in his/her Bid and will furnish bonds as described hereunder in Article 8 covering the faithful performance of the Contract and the payment of all obligations arising thereunder. Should the Bidder refuse to enter into such Contract or fail to furnish such bonds, the amount of the Bid Bond shall be forfeited to the Owner as liquidated damages, not as a penalty.
B. The Bond shall be prepared on the forms in the Bid Document, issued by a surety licensed to do business in the State of New Mexico listed on the current U.S. Treasury Surety List and acceptable to the Owner. The Attorney-In-Fact that executes the Bond on behalf of the Surety shall affix to the Bond a certified and current copy of his Power of Attorney.
C. The Owner will have the right to retain the Bid Security of Bidders until either (a) the Contract, has been executed and bonds have been furnished, or (b) the specified time has elapsed so that Bids may be withdrawn or (c) all Bids have been rejected.

4.3 Submission of Bids

A. All copies of the Bid, the Bid Security and any other documents required to be submitted with the Bid shall be enclosed in a sealed opaque envelope. The envelope shall be addressed as follows:

Dyron Murphy Architects, PC
Attn: Dyron V. Murphy, AIA
4505 Montbel Place NE
Albuquerque, New Mexico 87107

Bid Package for the
SHIPROCK FIRST RESPONDERS SUBSTATION FACILITY
DO NOT OPEN

If the Bid is sent by mail, the sealed envelope shall be enclosed in a separate mailing envelope with the notation "BID ENCLOSED" on the face, thereof. The

Owner assumes no responsibility for Bids delivered after the time and date of the Bid opening.

B. Bids shall be deposited at the designated location prior to the time and date for receipt of Bids indicated in the Invitation to Bid, or any extension thereof made by Addendum. Bids received after the time and date for receipt of Bids will be returned unopened.

C. Oral, telephonic, telegraphic, emailed, or faxed Bids are invalid and will not be considered.

D. Failure to include all required Bid Documents as stipulated will be cause for disqualification.

4.4 Modification or Withdrawal

A. A Bid may not be modified, withdrawn, or canceled by the Bidder during the stipulated time period following the time and date designated for the receipt of Bids, and Bidder so agrees in submitting the Bid.

B. Bids submitted early may be modified or withdrawn prior to the time designated for receipt of Bids.

C. Withdrawn Bids may be resubmitted up to the time designated for the receipt of Bids provided that they are then fully in conformance with these Instructions to Bidders.

4.5 Owner's Bid Declarations

A. It is the intent of the Owner to award a contract to the most qualified responsible Bidder, provided Bid has been submitted in accordance with the requirements of the Bid Documents and does not exceed the funds available. The Owner shall have the right to take such steps, as it deems necessary to determine the ability of the Bidder to perform the Project. Bidders shall furnish to the Owner such additional information and data for purpose as Owner may request. Owner reserves the right to reject any or all Bids that in the Owner's sole judgment are in the Owner's best interest.

4.6 Pre-Bid Conference

A. It remains the responsibility of the Bidder to exhibit due diligence in determining specific criteria and requirements related to this Bid procurement process and submittal. No Pre-Bid Conference has been scheduled, and if the Bidder wishes to examine the existing site conditions, they may do so by coordinating with the Owner's representative as listed under Part 1.2.

5.0 CONSIDERATION OF BIDS

5.1 Receipt of Bids

A. Bids will be received at the Architect's office, on the date and time specified on the Invitation to Bid. The Bids will be evaluated by the Architect thereafter to determine compliance with the bid documents.

5.2 Rejection of Bids

A. The Owner has the right to reject any or all Bids, reject a Bid not accompanied by any required Bid Security, or data required by the Bid Documents or a Bid, which is in any way incomplete or irregular. Conditional Bids will not be accepted.

5.3 Acceptance of Bid

A. The Owner has the right to waive any informality or irregularity in any Bid received.
B. It is the intent of the Owner to award a Contract to the most qualified responsible Bidder provided the Bid has been submitted in accord with the requirements of the Bid Documents and is judged to be reasonable.
C. If the Bid is within the amount of the funds available to finance the construction contract, then the contract award will be made to that responsible Bidder submitting the low Bid.

6.0 SUB-BIDDERS

6.1 Listing of Subcontractors and Suppliers

A. The Bidder shall list the Subcontractors or material suppliers they propose to use for all trades or items supplied, on the "Subcontractor List Form" attached.

1. The Bidder shall not list itself as the supplier or the Subcontractor for any trade unless he has previously performed Project of this type or can prove to the Architect's satisfaction that he/she actually has, or will obtain, fully adequate facilities and plans to perform the Project with his/her own forces.
2. Omission or non-compliance with the intent of the "Subcontractor List Form" will be grounds for considering a Bid as non-responsive.
3. The Bidder will, upon request, be required to establish to the satisfaction of the Architect and the Owner the reliability and responsibility of the proposed Subcontractors to furnish and perform the Project described in the Sections of the Specifications pertaining to the proposed Subcontractors respective trades.
4. Prior to the award of the Contract, the Architect will notify the Bidder, in writing, if either the Owner, after due investigation, has reasonable and substantial objection to any person or organization on such list. If the Owner has a reasonable and substantial objection to any person or organization on such list, and refuses in writing to accept such person or organization, the Bidder may, at their option, (1) withdraw their Bid, or (2) submit an acceptable substitute Subcontractor with no increase in the Bid price. In the event of withdrawal under this Subparagraph, Bid Security will not be forfeited, notwithstanding anything to the contrary in Paragraph above.

B. Subcontract awards shall be bound with the provisions outlined in the "Labor and Wage Standards", contained in the Contract Conditions section of the Bid Package.

7.0 PERFORMANCE BOND AND LABOR AND MATERIAL PAYMENT BOND

7.1 Security for Faithful Performance

A. The Bidder shall furnish and maintain bonds covering the faithful performance of the Contract, and the payment of all obligations arising thereunder, in an amount equal to one hundred percent (100%) of the Contract Sum as adjusted, and with such sureties secured through the Bidder's usual sources, licensed to do business in the State of New Mexico and as may be agreeable to the parties.

7.2 Time of Delivery and Form of Bonds

A. The Bidder shall deliver the required bonds to the Owner within ten (10) calendar days of receipt of written notice of award. If the Project must commence prior thereto, in response to a letter of Notice to Proceed from the Owner, the Bidder shall, prior to commencement of Project, submit evidence satisfactory to the Owner that such bonds will be furnished.
B. The bonds shall be written on the form(s) described under Bid Contract Documents.
C. The Bidder shall require the Attorney-In-Fact that executes the required bonds on behalf of the surety to affix thereto a certified and current copy of his/her Power of Attorney.

7.3 Taxes

A. It is understood that the stipulated sum or contract amount will not include the cost of state and local taxes. Navajo Tribal Taxes will be required. The Bidder shall make certain of any applicable Navajo Tribal Taxes be included in the Bid. The Bidder shall make inquiries to the Navajo Tax Commission, Window Rock, Arizona (928) 871-7610.

7.4 Arbitration

A. The "Arbitration" clauses or references in the General Conditions of the Contract for Construction (AIA Document A201) shall apply to this project.

7.5 Claims and Disputes

A. Any claims, disputes and other matters in question between the parties to this Agreement, shall be referred to the Architect by written notice within three (3) weeks of the date when the claim, dispute or other matter in question became known or should have become known to the complaining party.
B. Resolution shall be made between parties according to the Arbitration clauses set forth in the General Conditions of the Contract for Construction, unless otherwise noted.

7.6 Acknowledgments

A. This Agreement represents the entire and integrated Agreement between Owner and Contractor and supersedes all prior negotiations, representations or Agreements, either written or oral. This Agreement may be amended only by written instrument signed by both Owner and Contractor.

8.0 SPECIAL BINDING AND CONTRACT PROVISIONS

8.1 Submission Materials

A. Letter of certification from the Bidder, attesting to Bidder's compliance with Navajo Nation Wage and Labor Standards as stipulated in the Bid Documents.
B. Identification (Names, addresses, and telephone numbers) of declared Indian laborers or subcontractors for the Project to be performed, and the appropriate percentage (%) of total workforce in relation to the proposed Bid amount.

9.0 FORM OF AGREEMENT BETWEEN OWNER AND BIDDER

9.1 Form to be Used

A. The Agreement for the Project will be written on the forms indicated under the Bid Contract Documents.

10.0 LIQUIDATED DAMAGES

10.1 Time of Completion

A. Bidder must agree to commence Project on a date specified in a written "Notice to Proceed" issued by the Owner. The Bidder must agree to complete the Project within 450 calendar days commencing on the date of the “Notice to Proceed”.

10.2 Assessment

A. Liquidated Damages will be assessed on this project at a rate of $ 1,000.00 per calendar day beyond the contract time agreed upon in the contract documents, unless amended due to delays beyond the control of the Bidder and/or Owner.

11.0 MISCELLANEOUS PROVISIONS

11.1 Permits and Fees

A. Contractor shall pay for all permits and fees applicable to the project that is required by Government, State and Local municipalities.
B. Bidder's attention is drawn to the Navajo Nation Gross Receipts Tax documents attached herein, for regulations and requirements related to business activities on the Navajo Reservation.

END OF INSTRUCTIONS TO BIDDERS

BID FORM

PROJECT NAME: Shiprock First Responders Substation Facility
Shiprock, Navajo Nation, New Mexico
Architect's Project No. 2023.16
Owner's Bid No. 24-01-3222SB
Bid Submittal Date: March 14, 2024
To: Navajo Nation (hereinafter called the "Owner").

Bidder Name/Entity:_____

The Bidder, organized and existing under the laws of the State of _____, doing business as a Corporation, Partnership or Individual. (Identify organization structure).

The undersigned Bidder's representative acknowledges receipt of the following Addenda, if applicable:

Addendum No: ___, dated _____, Addendum No: ___, dated _____

Addendum No: ___, dated _____, Addendum No: ___, dated _____

Bid amount submittal requirement: Amounts to be shown in both words and figures. In case of a discrepancy, the amount shown in words will govern, please print.) All sums must include Navajo Nation Tax, including all permits and fees if required by authorities having jurisdiction.

Total Base Bid
/Dollars/Cents
$
Navajo Nation Tax Amount, Included in Base Bid Amount:
$

The undersigned, as an authorized representative for the Bidder named above, in compliance with the Invitation to Bid for the Project identified above having examined the Bid Documents, and having examined the site of the proposed work, and being familiar with all of the conditions surrounding the construction of the proposed project, including the availability of labor, materials and supplies, hereby proposes to furnish all labor, materials and supplies, and to construct the project in accordance with the contract documents at the prices stated herein. These prices are to cover all expenses incurred in performing the work required under the contract documents, of which this proposal is a part.

The Bidder understands that the contract will be awarded in accordance with the provisions of the Instructions to Bidders and that the Owner reserves the right to reject any or all bids and to waive any formalities in the bid process.

The Bidder agrees that this bid shall be good and may not be withdrawn for a period of One Hundred and Twenty (120) calendar days after the scheduled closing time for receiving bids.

Upon receipt of written notice of acceptance of this bid, Bidder will execute the final contract and deliver surety bonds as stipulated in the “Instructions to Bidders”.

The BID SECURITY attached in the sum of 10% of the bid amount is:

_____ Dollars,

($_____)

and shall become the property of the Owner in the event the contract and bonds are not executed within the time set forth herein, as liquidated damages for the delay and additional expenses to the Owner caused thereby.

Respectfully Submitted,

By: _____
Authorized Agent (Typed/Printed)

_____
Signature

_____
Date

_____
Company Name

_____

_____
Company Address

Telephone: _____

(Affix Corporate Seal if bid by Corporation)

BID BOND

KNOW ALL MEN BY THESE PRESENTS, That we the undersigned,

_____
(Name of Principal)

as PRINCIPAL, and

_____, as SURETY are held and
(Name of Surety)
firmly bound unto NAVAJO NATION, hereinafter called the "Owner", in the penal sum of $_____
_____ Dollars, lawful money of the United States, for the payment of which sum will and truly to be made, we bind ourselves, our heirs, executors, administrators, successors, and assigns, jointly and severally, firmly by these presents.

THE CONDITIONS OF THIS OBLIGATION IS SUCH, that whereas the Principal has submitted the accompanying bid dated March 14, 2024 for the Shiprock First Responders Substation Facility Project.

NOW, THEREFORE, if the Principal shall not withdraw said bid within the period specified therein after the opening of the same, or if no period be specified, within one hundred twenty (120) days after said opening, and shall within the period specified therefore, or, if no period be specified within ten (10) days after the prescribed forms are presented to for signature, enter into a written contract with the Owner in accordance with the bid as accepted, and give the required performance and payment security, for the faithful performance and proper fulfillment of such contract; or in the event of the withdrawal of said bid within the period specified, or the failure to enter into such contract and give such security within the time specified, if the Principal shall pay the Owner the difference between the amount specified in said bid and the amount for which the Owner may procure the required work or supplies or both, if the latter amount to be in excess of the former, then the above obligation shall be avid and of no effect, otherwise to remain in full force and virtue.

IN WITNESS WHEREOF, the above-bounded parties have executed this instrument under their several seals this _____ day of _____, 2024, the name and corporate seal of each corporate party being hereto affixed and these presents duly signed by its undersigned representative, pursuant to authority of its governing body.

In presence of

_____ _____ (SEAL)
(Individual Principal)

_____ _____
(Business Principal)

ATTEST:

_____ _____
(Corporate Principal)

_____

_____

_____

(Business Address)

BY:_____

Affix Corporate Seal

ATTEST:

_____ _____
(Corporate Surety)

_____

_____

_____
(Business Address)

BY:_____

Affix Corporate Seal

(Power of Attorney for person signing for Surety Company must be attached to Bond)

CERTIFICATE AS TO CORPORATE PRINCIPAL

I, _____, certify that I am the _____ (Title) of the Corporation named as Principal in the within Bond; that _____, who signed the said Bond on behalf of the Principal was then _____, of said Corporation; that I know his signature, and his signature thereto is genuine; and that said Bond was duly signed, sealed, and attested to for and in behalf of said corporation by authority of its governing body.

_____ (Corp. Seal)

SUBCONTRACTOR LIST FORM

1. GENERAL:

A. The Contractor must list below the name and address of all qualified Subcontractor's or suppliers he/she will employ for the various portions of the work indicated. Failure on the part of the Contractor to complete or property complete this list will constitute sufficient grounds to reject his/her bid. Additionally, the Contractor shall declare whether subcontractors listed herein are Navajo or Non-Navajo Owned businesses.

B. The Contractor may list him/herself to perform one or more of the listed categories of work for which he has any requisite state licenses when required. In this case, all personnel performing such work at the site shall be carried on his/her own payroll, except that he/she may sublet those portions of the work that are traditionally and commonly sublet by the representative Subcontractor in the community. If equipment is leased with operators, the operators need not be carried on the Contractor's payroll.

C. List only a single name for each listing. If a change occurs in the list, brought about by the exercising of any of the alternates involved in the Bid Form, the Bidder must show this change on the list. If no name appears other than those listed under the base bid, adherence to those names will be required no matter which alternate, if any, is exercised.

2. TRADES

TRADE	SUBCONTRACTOR/SUPPLIER NAME/ADDRESS	Navajo-Owned? Y/N
Concrete		
Reinforced Masonry		
Rough Carpentry		
Structural Steel		
Architectural Woodwork		
Insulation		
Roofing		
Doors/Windows		
Door Hardware		
Gypsum Board Assemblies		
Acoustical Ceilings		
Carpet Tile		
Painting		
Fire Protection Specialties		

Plumbing-Site		
Plumbing-Building		
HVAC		
Electrical-Site		
Electrical- Building		
Earthwork		
Asphalt Paving		
Concrete Paving		
Fencing		
Site Utilities		
Other (specify)		

END OF SUBCONTRACTOR LIST FORM

AFFIDAVIT OF NON-COLLUSION

for Construction of the

Shiprock First Responders Substation Facility

located in the **Shiprock** Chapter of the Navajo Nation, State of New Mexico, San Juan County

To the Owner: Navajo Nation

Affiant:_____, being first duly sworn, hereby deposes and says:
Printed Name

1. that he/she is the_____of _____the Business Entity
owner, partner, officer, representative agent company, firm, partnership, etc.
that has submitted/is submitting to the Owner, a Bid Proposal for the above-named Project;
2. that Affiant is fully informed with respect to the preparation and contents of the Bid submitted by said Business Entity for the above-named Project, and with respect to all pertinent circumstances regarding the submission of said Bid to the Owner;
3. that he/she is authorized to represent said Business Entity for purposes of the declarations set forth herein, and that all such declarations are made on behalf of said Entity and all of its owners, partners, officers, members, employees, officials, agents, or parties-in-interest;
4. that said Bid is genuine and not collusive or sham;
5. that said Entity has not in any manner colluded, conspired, connived, or agreed, directly or indirectly, with any other entity, bidder, or person, to submit a sham Bid to the Owner in connection with the proposed Contract for which said Bid was submitted, or to refrain from submitting a Bid to the Owner in connection with the proposed Contract;
6. that said Entity has not in any manner, directly or indirectly, sought by agreement or collusion, or communication or conference, with any other entity, bidder, or person, to fix any price or fee relating to any Bid of Entity or of any other entity, bidder, or person, or to fix any price, overhead, profit, reimbursement, or cost element of said Bid, or of that of any other entity, bidder, or person;
7. that said Entity has not -through any collusion, conspiracy, connivance, or unlawful written or oral agreement- secured any advantage against the Owner or against any other entity, bidder or person interested in the proposed Contract for the above-named Project;
8. that all statements set forth herein, and in said Bid submitted to the Owner, are true.

Signature of Affiant:

_____

Address of Business Entity:

_____

_____

NOTARY:

Subscribed and sworn to before me this _____ day of _____, 20____.

Notary Signature

_____

My Commission Expires

_____, 20____.

DRAFT

AIA® Document A101® – 2017

Standard Form of Agreement Between Owner and Contractor where the basis of payment is a Stipulated Sum

AGREEMENT made as of the « » day of « » in the year « »
(In words, indicate day, month and year.)

BETWEEN the Owner:
(Name, legal status, address and other information)

« »« »
« »
« »
« »

and the Contractor:
(Name, legal status, address and other information)

« »« »
« »
« »
« »

for the following Project:
(Name, location and detailed description)

« »
« »
« »

The Architect:
(Name, legal status, address and other information)

« »« »
« »
« »
« »

The Owner and Contractor agree as follows.

ADDITIONS AND DELETIONS: The author of this document has added information needed for its completion. The author may also have revised the text of the original AIA standard form. An *Additions and Deletions Report* that notes added information as well as revisions to the standard form text is available from the author and should be reviewed.

This document has important legal consequences. Consultation with an attorney is encouraged with respect to its completion or modification.

The parties should complete A101®–2017, Exhibit A, Insurance and Bonds, contemporaneously with this Agreement. AIA Document A201®–2017, General Conditions of the Contract for Construction, is adopted in this document by reference. Do not use with other general conditions unless this document is modified.

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TABLE OF ARTICLES

1 THE CONTRACT DOCUMENTS

2 THE WORK OF THIS CONTRACT

3 DATE OF COMMENCEMENT AND SUBSTANTIAL COMPLETION

4 CONTRACT SUM

5 PAYMENTS

6 DISPUTE RESOLUTION

7 TERMINATION OR SUSPENSION

8 MISCELLANEOUS PROVISIONS

9 ENUMERATION OF CONTRACT DOCUMENTS

EXHIBIT A INSURANCE AND BONDS

ARTICLE 1 THE CONTRACT DOCUMENTS

The Contract Documents consist of this Agreement, Conditions of the Contract (General, Supplementary, and other Conditions), Drawings, Specifications, Addenda issued prior to execution of this Agreement, other documents listed in this Agreement, and Modifications issued after execution of this Agreement, all of which form the Contract, and are as fully a part of the Contract as if attached to this Agreement or repeated herein. The Contract represents the entire and integrated agreement between the parties hereto and supersedes prior negotiations, representations, or agreements, either written or oral. An enumeration of the Contract Documents, other than a Modification, appears in Article 9.

ARTICLE 2 THE WORK OF THIS CONTRACT

The Contractor shall fully execute the Work described in the Contract Documents, except as specifically indicated in the Contract Documents to be the responsibility of others.

ARTICLE 3 DATE OF COMMENCEMENT AND SUBSTANTIAL COMPLETION

§ 3.1 The date of commencement of the Work shall be:
(Check one of the following boxes.)

[« »] The date of this Agreement.

[« »] A date set forth in a notice to proceed issued by the Owner.

[« »] Established as follows:
(Insert a date or a means to determine the date of commencement of the Work.)

« »

If a date of commencement of the Work is not selected, then the date of commencement shall be the date of this Agreement.

§ 3.2 The Contract Time shall be measured from the date of commencement of the Work.

§ 3.3 Substantial Completion

§ 3.3.1 Subject to adjustments of the Contract Time as provided in the Contract Documents, the Contractor shall achieve Substantial Completion of the entire Work:
(Check one of the following boxes and complete the necessary information.)

[« »] Not later than « » (« ») calendar days from the date of commencement of the Work.

[« »] By the following date: « »

§ 3.3.2 Subject to adjustments of the Contract Time as provided in the Contract Documents, if portions of the Work are to be completed prior to Substantial Completion of the entire Work, the Contractor shall achieve Substantial Completion of such portions by the following dates:

Portion of Work	Substantial Completion Date

§ 3.3.3 If the Contractor fails to achieve Substantial Completion as provided in this Section 3.3, liquidated damages, if any, shall be assessed as set forth in Section 4.5.

ARTICLE 4 CONTRACT SUM

§ 4.1 The Owner shall pay the Contractor the Contract Sum in current funds for the Contractor's performance of the Contract. The Contract Sum shall be « » ($ « »), subject to additions and deductions as provided in the Contract Documents.

§ 4.2 Alternates

§ 4.2.1 Alternates, if any, included in the Contract Sum:

Item	Price

§ 4.2.2 Subject to the conditions noted below, the following alternates may be accepted by the Owner following execution of this Agreement. Upon acceptance, the Owner shall issue a Modification to this Agreement.
(Insert below each alternate and the conditions that must be met for the Owner to accept the alternate.)

Item	Price	Conditions for Acceptance

§ 4.3 Allowances, if any, included in the Contract Sum:
(Identify each allowance.)

Item	Price

§ 4.4 Unit prices, if any:
(Identify the item and state the unit price and quantity limitations, if any, to which the unit price will be applicable.)

Item	Units and Limitations	Price per Unit ($0.00)

§ 4.5 Liquidated damages, if any:
(Insert terms and conditions for liquidated damages, if any.)

« »

§ 4.6 Other:
(Insert provisions for bonus or other incentives, if any, that might result in a change to the Contract Sum.)

« »

ARTICLE 5 PAYMENTS

§ 5.1 Progress Payments

§ 5.1.1 Based upon Applications for Payment submitted to the Architect by the Contractor and Certificates for Payment issued by the Architect, the Owner shall make progress payments on account of the Contract Sum to the Contractor as provided below and elsewhere in the Contract Documents.

§ 5.1.2 The period covered by each Application for Payment shall be one calendar month ending on the last day of the month, or as follows:

« »

§ 5.1.3 Provided that an Application for Payment is received by the Architect not later than the « » day of a month, the Owner shall make payment of the amount certified to the Contractor not later than the « » day of the « » month. If an Application for Payment is received by the Architect after the application date fixed above, payment of the amount certified shall be made by the Owner not later than « » (« ») days after the Architect receives the Application for Payment.
(Federal, state or local laws may require payment within a certain period of time.)

§ 5.1.4 Each Application for Payment shall be based on the most recent schedule of values submitted by the Contractor in accordance with the Contract Documents. The schedule of values shall allocate the entire Contract Sum among the various portions of the Work. The schedule of values shall be prepared in such form, and supported by such data to substantiate its accuracy, as the Architect may require. This schedule of values shall be used as a basis for reviewing the Contractor's Applications for Payment.

§ 5.1.5 Applications for Payment shall show the percentage of completion of each portion of the Work as of the end of the period covered by the Application for Payment.

§ 5.1.6 In accordance with AIA Document A201™–2017, General Conditions of the Contract for Construction, and subject to other provisions of the Contract Documents, the amount of each progress payment shall be computed as follows:

§ 5.1.6.1 The amount of each progress payment shall first include:

.1 That portion of the Contract Sum properly allocable to completed Work;

.2 That portion of the Contract Sum properly allocable to materials and equipment delivered and suitably stored at the site for subsequent incorporation in the completed construction, or, if approved in advance by the Owner, suitably stored off the site at a location agreed upon in writing; and

.3 That portion of Construction Change Directives that the Architect determines, in the Architect's professional judgment, to be reasonably justified.

§ 5.1.6.2 The amount of each progress payment shall then be reduced by:

.1 The aggregate of any amounts previously paid by the Owner;

.2 The amount, if any, for Work that remains uncorrected and for which the Architect has previously withheld a Certificate for Payment as provided in Article 9 of AIA Document A201–2017;

.3 Any amount for which the Contractor does not intend to pay a Subcontractor or material supplier, unless the Work has been performed by others the Contractor intends to pay;

.4 For Work performed or defects discovered since the last payment application, any amount for which the Architect may withhold payment, or nullify a Certificate of Payment in whole or in part, as provided in Article 9 of AIA Document A201–2017; and

.5 Retainage withheld pursuant to Section 5.1.7.

§ 5.1.7 Retainage

§ 5.1.7.1 For each progress payment made prior to Substantial Completion of the Work, the Owner may withhold the following amount, as retainage, from the payment otherwise due:
(Insert a percentage or amount to be withheld as retainage from each Application for Payment. The amount of retainage may be limited by governing law.)

« »

§ 5.1.7.1.1 The following items are not subject to retainage:
(Insert any items not subject to the withholding of retainage, such as general conditions, insurance, etc.)

« »

§ 5.1.7.2 Reduction or limitation of retainage, if any, shall be as follows:
(If the retainage established in Section 5.1.7.1 is to be modified prior to Substantial Completion of the entire Work, including modifications for Substantial Completion of portions of the Work as provided in Section 3.3.2, insert provisions for such modifications.)

« »

§ 5.1.7.3 Except as set forth in this Section 5.1.7.3, upon Substantial Completion of the Work, the Contractor may submit an Application for Payment that includes the retainage withheld from prior Applications for Payment pursuant to this Section 5.1.7. The Application for Payment submitted at Substantial Completion shall not include retainage as follows:
(Insert any other conditions for release of retainage upon Substantial Completion.)

« »

§ 5.1.8 If final completion of the Work is materially delayed through no fault of the Contractor, the Owner shall pay the Contractor any additional amounts in accordance with Article 9 of AIA Document A201–2017.

§ 5.1.9 Except with the Owner's prior approval, the Contractor shall not make advance payments to suppliers for materials or equipment which have not been delivered and stored at the site.

§ 5.2 Final Payment

§ 5.2.1 Final payment, constituting the entire unpaid balance of the Contract Sum, shall be made by the Owner to the Contractor when

.1 the Contractor has fully performed the Contract except for the Contractor's responsibility to correct Work as provided in Article 12 of AIA Document A201–2017, and to satisfy other requirements, if any, which extend beyond final payment; and

.2 a final Certificate for Payment has been issued by the Architect.

§ 5.2.2 The Owner's final payment to the Contractor shall be made no later than 30 days after the issuance of the Architect's final Certificate for Payment, or as follows:

« »

§ 5.3 Interest

Payments due and unpaid under the Contract shall bear interest from the date payment is due at the rate stated below, or in the absence thereof, at the legal rate prevailing from time to time at the place where the Project is located.
(Insert rate of interest agreed upon, if any.)

« » % « »

ARTICLE 6 DISPUTE RESOLUTION

§ 6.1 Initial Decision Maker

The Architect will serve as the Initial Decision Maker pursuant to Article 15 of AIA Document A201–2017, unless the parties appoint below another individual, not a party to this Agreement, to serve as the Initial Decision Maker.
(If the parties mutually agree, insert the name, address and other contact information of the Initial Decision Maker, if other than the Architect.)

« »
« »
« »

« »

§ 6.2 Binding Dispute Resolution

For any Claim subject to, but not resolved by, mediation pursuant to Article 15 of AIA Document A201–2017, the method of binding dispute resolution shall be as follows:
(Check the appropriate box.)

[« »] Arbitration pursuant to Section 15.4 of AIA Document A201–2017

[« »] Litigation in a court of competent jurisdiction

[« »] Other *(Specify)*

« »

If the Owner and Contractor do not select a method of binding dispute resolution, or do not subsequently agree in writing to a binding dispute resolution method other than litigation, Claims will be resolved by litigation in a court of competent jurisdiction.

ARTICLE 7 TERMINATION OR SUSPENSION

§ 7.1 The Contract may be terminated by the Owner or the Contractor as provided in Article 14 of AIA Document A201–2017.

§ 7.1.1 If the Contract is terminated for the Owner's convenience in accordance with Article 14 of AIA Document A201–2017, then the Owner shall pay the Contractor a termination fee as follows:
(Insert the amount of, or method for determining, the fee, if any, payable to the Contractor following a termination for the Owner's convenience.)

« »

§ 7.2 The Work may be suspended by the Owner as provided in Article 14 of AIA Document A201–2017.

ARTICLE 8 MISCELLANEOUS PROVISIONS

§ 8.1 Where reference is made in this Agreement to a provision of AIA Document A201–2017 or another Contract Document, the reference refers to that provision as amended or supplemented by other provisions of the Contract Documents.

§ 8.2 The Owner's representative:
(Name, address, email address, and other information)

« »
« »
« »
« »
« »
« »

§ 8.3 The Contractor's representative:
(Name, address, email address, and other information)

« »
« »
« »
« »
« »
« »

§ 8.4 Neither the Owner's nor the Contractor's representative shall be changed without ten days' prior notice to the other party.

§ 8.5 Insurance and Bonds

§ 8.5.1 The Owner and the Contractor shall purchase and maintain insurance as set forth in AIA Document A101™–2017, Standard Form of Agreement Between Owner and Contractor where the basis of payment is a Stipulated Sum, Exhibit A, Insurance and Bonds, and elsewhere in the Contract Documents.

§ 8.5.2 The Contractor shall provide bonds as set forth in AIA Document A101™–2017 Exhibit A, and elsewhere in the Contract Documents.

§ 8.6 Notice in electronic format, pursuant to Article 1 of AIA Document A201–2017, may be given in accordance with AIA Document E203™–2013, Building Information Modeling and Digital Data Exhibit, if completed, or as otherwise set forth below:
(If other than in accordance with AIA Document E203–2013, insert requirements for delivering notice in electronic format such as name, title, and email address of the recipient and whether and how the system will be required to generate a read receipt for the transmission.)

« »

§ 8.7 Other provisions:

« »

ARTICLE 9 ENUMERATION OF CONTRACT DOCUMENTS

§ 9.1 This Agreement is comprised of the following documents:

.1 AIA Document A101™–2017, Standard Form of Agreement Between Owner and Contractor

.2 AIA Document A101™–2017, Exhibit A, Insurance and Bonds

.3 AIA Document A201™–2017, General Conditions of the Contract for Construction

.4 AIA Document E203™–2013, Building Information Modeling and Digital Data Exhibit, dated as indicated below:
(Insert the date of the E203-2013 incorporated into this Agreement.)

« »

.5 Drawings

Number	Title	Date

.6 Specifications

Section	Title	Date	Pages

.7 Addenda, if any:

Number	Date	Pages

Portions of Addenda relating to bidding or proposal requirements are not part of the Contract Documents unless the bidding or proposal requirements are also enumerated in this Article 9.

.8 Other Exhibits:
(Check all boxes that apply and include appropriate information identifying the exhibit where required.)

[« »] AIA Document E204™–2017, Sustainable Projects Exhibit, dated as indicated below:
(Insert the date of the E204-2017 incorporated into this Agreement.)

« »

[« »] The Sustainability Plan:

Title	Date	Pages

[« »] Supplementary and other Conditions of the Contract:

Document	Title	Date	Pages

.9 Other documents, if any, listed below:
(List here any additional documents that are intended to form part of the Contract Documents. AIA Document A201™–2017 provides that the advertisement or invitation to bid, Instructions to Bidders, sample forms, the Contractor's bid or proposal, portions of Addenda relating to bidding or proposal requirements, and other information furnished by the Owner in anticipation of receiving bids or proposals, are not part of the Contract Documents unless enumerated in this Agreement. Any such documents should be listed here only if intended to be part of the Contract Documents.)

« »

This Agreement entered into as of the day and year first written above.

OWNER *(Signature)*	**CONTRACTOR** *(Signature)*
« »« »	« »« »
(Printed name and title)	*(Printed name and title)*

CONTRACT FORMS, BONDS AND CERTIFICATES

Contract Forms anticipated to be utilized on this project, unless otherwise declared, are listed below.

1. AIA Document A101-2017 Ed., *"Standard Form of Agreement Between Owner and Contractor"* - To be executed by the Owner with the successful bidder.

2. AIA Document A201™–2017 *"General Conditions of the Contract for Construction"* - To be executed by the Owner with the successful bidder.

3. AIA Document A312™–2010 "*Performance Bond and Payment Bond"* - for 100% of the contract amount to be executed by the Contractor.

4. AIA Document G702™–1992 "*Application and Certificate for Payment"* -Executed by the Contractor, submitted each payment period as specified in the contract.

5. AIA Document G704™–2000 "*Certificate of Substantial Completion"*

6. AIA Document G706™–1994 "*Contractor's Affidavit of Payment of Debts and Claims"*

7. AIA Document G710™–1992 "*Architect's Supplemental Instructions"*

END OF FORMS, BONDS AND CERTIFICATES

DRAFT

AIA® Document A201® – 2017

General Conditions of the Contract for Construction

for the following PROJECT:
(Name and location or address)

« »
« »

THE OWNER:
(Name, legal status and address)

« »« »
« »

THE ARCHITECT:
(Name, legal status and address)

« »« »
« »

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15 CLAIMS AND DISPUTES

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For guidance in modifying this document to include supplementary conditions, see AIA Document A503™, Guide for Supplementary Conditions.

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ARTICLE 1 GENERAL PROVISIONS

§ 1.1 Basic Definitions

§ 1.1.1 The Contract Documents

The Contract Documents are enumerated in the Agreement between the Owner and Contractor (hereinafter the Agreement) and consist of the Agreement, Conditions of the Contract (General, Supplementary and other Conditions), Drawings, Specifications, Addenda issued prior to execution of the Contract, other documents listed in the Agreement, and Modifications issued after execution of the Contract. A Modification is (1) a written amendment to the Contract signed by both parties, (2) a Change Order, (3) a Construction Change Directive, or (4) a written order for a minor change in the Work issued by the Architect. Unless specifically enumerated in the Agreement, the Contract Documents do not include the advertisement or invitation to bid, Instructions to Bidders, sample forms, other information furnished by the Owner in anticipation of receiving bids or proposals, the Contractor's bid or proposal, or portions of Addenda relating to bidding or proposal requirements.

§ 1.1.2 The Contract

The Contract Documents form the Contract for Construction. The Contract represents the entire and integrated agreement between the parties hereto and supersedes prior negotiations, representations, or agreements, either written or oral. The Contract may be amended or modified only by a Modification. The Contract Documents shall not be construed to create a contractual relationship of any kind (1) between the Contractor and the Architect or the Architect's consultants, (2) between the Owner and a Subcontractor or a Sub-subcontractor, (3) between the Owner and the Architect or the Architect's consultants, or (4) between any persons or entities other than the Owner and the Contractor. The Architect shall, however, be entitled to performance and enforcement of obligations under the Contract intended to facilitate performance of the Architect's duties.

§ 1.1.3 The Work

The term "Work" means the construction and services required by the Contract Documents, whether completed or partially completed, and includes all other labor, materials, equipment, and services provided or to be provided by the Contractor to fulfill the Contractor's obligations. The Work may constitute the whole or a part of the Project.

§ 1.1.4 The Project

The Project is the total construction of which the Work performed under the Contract Documents may be the whole or a part and which may include construction by the Owner and by Separate Contractors.

§ 1.1.5 The Drawings

The Drawings are the graphic and pictorial portions of the Contract Documents showing the design, location and dimensions of the Work, generally including plans, elevations, sections, details, schedules, and diagrams.

§ 1.1.6 The Specifications

The Specifications are that portion of the Contract Documents consisting of the written requirements for materials, equipment, systems, standards and workmanship for the Work, and performance of related services.

§ 1.1.7 Instruments of Service

Instruments of Service are representations, in any medium of expression now known or later developed, of the tangible and intangible creative work performed by the Architect and the Architect's consultants under their respective professional services agreements. Instruments of Service may include, without limitation, studies, surveys, models, sketches, drawings, specifications, and other similar materials.

§ 1.1.8 Initial Decision Maker

The Initial Decision Maker is the person identified in the Agreement to render initial decisions on Claims in accordance with Section 15.2. The Initial Decision Maker shall not show partiality to the Owner or Contractor and shall not be liable for results of interpretations or decisions rendered in good faith.

§ 1.2 Correlation and Intent of the Contract Documents

§ 1.2.1 The intent of the Contract Documents is to include all items necessary for the proper execution and completion of the Work by the Contractor. The Contract Documents are complementary, and what is required by one shall be as binding as if required by all; performance by the Contractor shall be required only to the extent consistent with the Contract Documents and reasonably inferable from them as being necessary to produce the indicated results.

§ 1.2.1.1 The invalidity of any provision of the Contract Documents shall not invalidate the Contract or its remaining provisions. If it is determined that any provision of the Contract Documents violates any law, or is otherwise invalid or unenforceable, then that provision shall be revised to the extent necessary to make that provision legal and enforceable. In such case the Contract Documents shall be construed, to the fullest extent permitted by law, to give effect to the parties' intentions and purposes in executing the Contract.

§ 1.2.2 Organization of the Specifications into divisions, sections and articles, and arrangement of Drawings shall not control the Contractor in dividing the Work among Subcontractors or in establishing the extent of Work to be performed by any trade.

§ 1.2.3 Unless otherwise stated in the Contract Documents, words that have well-known technical or construction industry meanings are used in the Contract Documents in accordance with such recognized meanings.

§ 1.3 Capitalization

Terms capitalized in these General Conditions include those that are (1) specifically defined, (2) the titles of numbered articles, or (3) the titles of other documents published by the American Institute of Architects.

§ 1.4 Interpretation

In the interest of brevity the Contract Documents frequently omit modifying words such as "all" and "any" and articles such as "the" and "an," but the fact that a modifier or an article is absent from one statement and appears in another is not intended to affect the interpretation of either statement.

§ 1.5 Ownership and Use of Drawings, Specifications, and Other Instruments of Service

§ 1.5.1 The Architect and the Architect's consultants shall be deemed the authors and owners of their respective Instruments of Service, including the Drawings and Specifications, and retain all common law, statutory, and other reserved rights in their Instruments of Service, including copyrights. The Contractor, Subcontractors, Sub-subcontractors, and suppliers shall not own or claim a copyright in the Instruments of Service. Submittal or distribution to meet official regulatory requirements or for other purposes in connection with the Project is not to be construed as publication in derogation of the Architect's or Architect's consultants' reserved rights.

§ 1.5.2 The Contractor, Subcontractors, Sub-subcontractors, and suppliers are authorized to use and reproduce the Instruments of Service provided to them, subject to any protocols established pursuant to Sections 1.7 and 1.8, solely and exclusively for execution of the Work. All copies made under this authorization shall bear the copyright notice, if any, shown on the Instruments of Service. The Contractor, Subcontractors, Sub-subcontractors, and suppliers may not use the Instruments of Service on other projects or for additions to the Project outside the scope of the Work without the specific written consent of the Owner, Architect, and the Architect's consultants.

§ 1.6 Notice

§ 1.6.1 Except as otherwise provided in Section 1.6.2, where the Contract Documents require one party to notify or give notice to the other party, such notice shall be provided in writing to the designated representative of the party to whom the notice is addressed and shall be deemed to have been duly served if delivered in person, by mail, by courier, or by electronic transmission if a method for electronic transmission is set forth in the Agreement.

§ 1.6.2 Notice of Claims as provided in Section 15.1.3 shall be provided in writing and shall be deemed to have been duly served only if delivered to the designated representative of the party to whom the notice is addressed by certified or registered mail, or by courier providing proof of delivery.

§ 1.7 Digital Data Use and Transmission

The parties shall agree upon protocols governing the transmission and use of Instruments of Service or any other information or documentation in digital form. The parties will use AIA Document E203™–2013, Building Information Modeling and Digital Data Exhibit, to establish the protocols for the development, use, transmission, and exchange of digital data.

§ 1.8 Building Information Models Use and Reliance

Any use of, or reliance on, all or a portion of a building information model without agreement to protocols governing the use of, and reliance on, the information contained in the model and without having those protocols set forth in AIA Document E203™–2013, Building Information Modeling and Digital Data Exhibit, and the requisite AIA Document

G202™–2013, Project Building Information Modeling Protocol Form, shall be at the using or relying party's sole risk and without liability to the other party and its contractors or consultants, the authors of, or contributors to, the building information model, and each of their agents and employees.

ARTICLE 2 OWNER

§ 2.1 General

§ 2.1.1 The Owner is the person or entity identified as such in the Agreement and is referred to throughout the Contract Documents as if singular in number. The Owner shall designate in writing a representative who shall have express authority to bind the Owner with respect to all matters requiring the Owner's approval or authorization. Except as otherwise provided in Section 4.2.1, the Architect does not have such authority. The term "Owner" means the Owner or the Owner's authorized representative.

§ 2.1.2 The Owner shall furnish to the Contractor, within fifteen days after receipt of a written request, information necessary and relevant for the Contractor to evaluate, give notice of, or enforce mechanic's lien rights. Such information shall include a correct statement of the record legal title to the property on which the Project is located, usually referred to as the site, and the Owner's interest therein.

§ 2.2 Evidence of the Owner's Financial Arrangements

§ 2.2.1 Prior to commencement of the Work and upon written request by the Contractor, the Owner shall furnish to the Contractor reasonable evidence that the Owner has made financial arrangements to fulfill the Owner's obligations under the Contract. The Contractor shall have no obligation to commence the Work until the Owner provides such evidence. If commencement of the Work is delayed under this Section 2.2.1, the Contract Time shall be extended appropriately.

§ 2.2.2 Following commencement of the Work and upon written request by the Contractor, the Owner shall furnish to the Contractor reasonable evidence that the Owner has made financial arrangements to fulfill the Owner's obligations under the Contract only if (1) the Owner fails to make payments to the Contractor as the Contract Documents require; (2) the Contractor identifies in writing a reasonable concern regarding the Owner's ability to make payment when due; or (3) a change in the Work materially changes the Contract Sum. If the Owner fails to provide such evidence, as required, within fourteen days of the Contractor's request, the Contractor may immediately stop the Work and, in that event, shall notify the Owner that the Work has stopped. However, if the request is made because a change in the Work materially changes the Contract Sum under (3) above, the Contractor may immediately stop only that portion of the Work affected by the change until reasonable evidence is provided. If the Work is stopped under this Section 2.2.2, the Contract Time shall be extended appropriately and the Contract Sum shall be increased by the amount of the Contractor's reasonable costs of shutdown, delay and start-up, plus interest as provided in the Contract Documents.

§ 2.2.3 After the Owner furnishes evidence of financial arrangements under this Section 2.2, the Owner shall not materially vary such financial arrangements without prior notice to the Contractor.

§ 2.2.4 Where the Owner has designated information furnished under this Section 2.2 as "confidential," the Contractor shall keep the information confidential and shall not disclose it to any other person. However, the Contractor may disclose "confidential" information, after seven (7) days' notice to the Owner, where disclosure is required by law, including a subpoena or other form of compulsory legal process issued by a court or governmental entity, or by court or arbitrator(s) order. The Contractor may also disclose "confidential" information to its employees, consultants, sureties, Subcontractors and their employees, Sub-subcontractors, and others who need to know the content of such information solely and exclusively for the Project and who agree to maintain the confidentiality of such information.

§ 2.3 Information and Services Required of the Owner

§ 2.3.1 Except for permits and fees that are the responsibility of the Contractor under the Contract Documents, including those required under Section 3.7.1, the Owner shall secure and pay for necessary approvals, easements, assessments and charges required for construction, use or occupancy of permanent structures or for permanent changes in existing facilities.

§ 2.3.2 The Owner shall retain an architect lawfully licensed to practice architecture, or an entity lawfully practicing architecture, in the jurisdiction where the Project is located. That person or entity is identified as the Architect in the Agreement and is referred to throughout the Contract Documents as if singular in number.

§ 2.3.3 If the employment of the Architect terminates, the Owner shall employ a successor to whom the Contractor has no reasonable objection and whose status under the Contract Documents shall be that of the Architect.

§ 2.3.4 The Owner shall furnish surveys describing physical characteristics, legal limitations and utility locations for the site of the Project, and a legal description of the site. The Contractor shall be entitled to rely on the accuracy of information furnished by the Owner but shall exercise proper precautions relating to the safe performance of the Work.

§ 2.3.5 The Owner shall furnish information or services required of the Owner by the Contract Documents with reasonable promptness. The Owner shall also furnish any other information or services under the Owner's control and relevant to the Contractor's performance of the Work with reasonable promptness after receiving the Contractor's written request for such information or services.

§ 2.3.6 Unless otherwise provided in the Contract Documents, the Owner shall furnish to the Contractor one copy of the Contract Documents for purposes of making reproductions pursuant to Section 1.5.2.

§ 2.4 Owner's Right to Stop the Work

If the Contractor fails to correct Work that is not in accordance with the requirements of the Contract Documents as required by Section 12.2 or repeatedly fails to carry out Work in accordance with the Contract Documents, the Owner may issue a written order to the Contractor to stop the Work, or any portion thereof, until the cause for such order has been eliminated; however, the right of the Owner to stop the Work shall not give rise to a duty on the part of the Owner to exercise this right for the benefit of the Contractor or any other person or entity, except to the extent required by Section 6.1.3.

§ 2.5 Owner's Right to Carry Out the Work

If the Contractor defaults or neglects to carry out the Work in accordance with the Contract Documents and fails within a ten-day period after receipt of notice from the Owner to commence and continue correction of such default or neglect with diligence and promptness, the Owner may, without prejudice to other remedies the Owner may have, correct such default or neglect. Such action by the Owner and amounts charged to the Contractor are both subject to prior approval of the Architect and the Architect may, pursuant to Section 9.5.1, withhold or nullify a Certificate for Payment in whole or in part, to the extent reasonably necessary to reimburse the Owner for the reasonable cost of correcting such deficiencies, including Owner's expenses and compensation for the Architect's additional services made necessary by such default, neglect, or failure. If current and future payments are not sufficient to cover such amounts, the Contractor shall pay the difference to the Owner. If the Contractor disagrees with the actions of the Owner or the Architect, or the amounts claimed as costs to the Owner, the Contractor may file a Claim pursuant to Article 15.

ARTICLE 3 CONTRACTOR

§ 3.1 General

§ 3.1.1 The Contractor is the person or entity identified as such in the Agreement and is referred to throughout the Contract Documents as if singular in number. The Contractor shall be lawfully licensed, if required in the jurisdiction where the Project is located. The Contractor shall designate in writing a representative who shall have express authority to bind the Contractor with respect to all matters under this Contract. The term "Contractor" means the Contractor or the Contractor's authorized representative.

§ 3.1.2 The Contractor shall perform the Work in accordance with the Contract Documents.

§ 3.1.3 The Contractor shall not be relieved of its obligations to perform the Work in accordance with the Contract Documents either by activities or duties of the Architect in the Architect's administration of the Contract, or by tests, inspections or approvals required or performed by persons or entities other than the Contractor.

§ 3.2 Review of Contract Documents and Field Conditions by Contractor

§ 3.2.1 Execution of the Contract by the Contractor is a representation that the Contractor has visited the site, become generally familiar with local conditions under which the Work is to be performed, and correlated personal observations with requirements of the Contract Documents.

§ 3.2.2 Because the Contract Documents are complementary, the Contractor shall, before starting each portion of the Work, carefully study and compare the various Contract Documents relative to that portion of the Work, as well as the information furnished by the Owner pursuant to Section 2.3.4, shall take field measurements of any existing conditions related to that portion of the Work, and shall observe any conditions at the site affecting it. These obligations are for the purpose of facilitating coordination and construction by the Contractor and are not for the purpose of discovering errors, omissions, or inconsistencies in the Contract Documents; however, the Contractor shall promptly report to the Architect any errors, inconsistencies or omissions discovered by or made known to the Contractor as a request for information in such form as the Architect may require. It is recognized that the Contractor's review is made in the Contractor's capacity as a contractor and not as a licensed design professional, unless otherwise specifically provided in the Contract Documents.

§ 3.2.3 The Contractor is not required to ascertain that the Contract Documents are in accordance with applicable laws, statutes, ordinances, codes, rules and regulations, or lawful orders of public authorities, but the Contractor shall promptly report to the Architect any nonconformity discovered by or made known to the Contractor as a request for information in such form as the Architect may require.

§ 3.2.4 If the Contractor believes that additional cost or time is involved because of clarifications or instructions the Architect issues in response to the Contractor's notices or requests for information pursuant to Sections 3.2.2 or 3.2.3, the Contractor shall submit Claims as provided in Article 15. If the Contractor fails to perform the obligations of Sections 3.2.2 or 3.2.3, the Contractor shall pay such costs and damages to the Owner, subject to Section 15.1.7, as would have been avoided if the Contractor had performed such obligations. If the Contractor performs those obligations, the Contractor shall not be liable to the Owner or Architect for damages resulting from errors, inconsistencies or omissions in the Contract Documents, for differences between field measurements or conditions and the Contract Documents, or for nonconformities of the Contract Documents to applicable laws, statutes, ordinances, codes, rules and regulations, and lawful orders of public authorities.

§ 3.3 Supervision and Construction Procedures

§ 3.3.1 The Contractor shall supervise and direct the Work, using the Contractor's best skill and attention. The Contractor shall be solely responsible for, and have control over, construction means, methods, techniques, sequences, and procedures, and for coordinating all portions of the Work under the Contract. If the Contract Documents give specific instructions concerning construction means, methods, techniques, sequences, or procedures, the Contractor shall evaluate the jobsite safety thereof and shall be solely responsible for the jobsite safety of such means, methods, techniques, sequences, or procedures. If the Contractor determines that such means, methods, techniques, sequences or procedures may not be safe, the Contractor shall give timely notice to the Owner and Architect, and shall propose alternative means, methods, techniques, sequences, or procedures. The Architect shall evaluate the proposed alternative solely for conformance with the design intent for the completed construction. Unless the Architect objects to the Contractor's proposed alternative, the Contractor shall perform the Work using its alternative means, methods, techniques, sequences, or procedures.

§ 3.3.2 The Contractor shall be responsible to the Owner for acts and omissions of the Contractor's employees, Subcontractors and their agents and employees, and other persons or entities performing portions of the Work for, or on behalf of, the Contractor or any of its Subcontractors.

§ 3.3.3 The Contractor shall be responsible for inspection of portions of Work already performed to determine that such portions are in proper condition to receive subsequent Work.

§ 3.4 Labor and Materials

§ 3.4.1 Unless otherwise provided in the Contract Documents, the Contractor shall provide and pay for labor, materials, equipment, tools, construction equipment and machinery, water, heat, utilities, transportation, and other facilities and services necessary for proper execution and completion of the Work, whether temporary or permanent and whether or not incorporated or to be incorporated in the Work.

§ 3.4.2 Except in the case of minor changes in the Work approved by the Architect in accordance with Section 3.12.8 or ordered by the Architect in accordance with Section 7.4, the Contractor may make substitutions only with the consent of the Owner, after evaluation by the Architect and in accordance with a Change Order or Construction Change Directive.

§ 3.4.3 The Contractor shall enforce strict discipline and good order among the Contractor's employees and other persons carrying out the Work. The Contractor shall not permit employment of unfit persons or persons not properly skilled in tasks assigned to them.

§ 3.5 Warranty

§ 3.5.1 The Contractor warrants to the Owner and Architect that materials and equipment furnished under the Contract will be of good quality and new unless the Contract Documents require or permit otherwise. The Contractor further warrants that the Work will conform to the requirements of the Contract Documents and will be free from defects, except for those inherent in the quality of the Work the Contract Documents require or permit. Work, materials, or equipment not conforming to these requirements may be considered defective. The Contractor's warranty excludes remedy for damage or defect caused by abuse, alterations to the Work not executed by the Contractor, improper or insufficient maintenance, improper operation, or normal wear and tear and normal usage. If required by the Architect, the Contractor shall furnish satisfactory evidence as to the kind and quality of materials and equipment.

§ 3.5.2 All material, equipment, or other special warranties required by the Contract Documents shall be issued in the name of the Owner, or shall be transferable to the Owner, and shall commence in accordance with Section 9.8.4.

§ 3.6 Taxes

The Contractor shall pay sales, consumer, use and similar taxes for the Work provided by the Contractor that are legally enacted when bids are received or negotiations concluded, whether or not yet effective or merely scheduled to go into effect.

§ 3.7 Permits, Fees, Notices and Compliance with Laws

§ 3.7.1 Unless otherwise provided in the Contract Documents, the Contractor shall secure and pay for the building permit as well as for other permits, fees, licenses, and inspections by government agencies necessary for proper execution and completion of the Work that are customarily secured after execution of the Contract and legally required at the time bids are received or negotiations concluded.

§ 3.7.2 The Contractor shall comply with and give notices required by applicable laws, statutes, ordinances, codes, rules and regulations, and lawful orders of public authorities applicable to performance of the Work.

§ 3.7.3 If the Contractor performs Work knowing it to be contrary to applicable laws, statutes, ordinances, codes, rules and regulations, or lawful orders of public authorities, the Contractor shall assume appropriate responsibility for such Work and shall bear the costs attributable to correction.

§ 3.7.4 Concealed or Unknown Conditions

If the Contractor encounters conditions at the site that are (1) subsurface or otherwise concealed physical conditions that differ materially from those indicated in the Contract Documents or (2) unknown physical conditions of an unusual nature that differ materially from those ordinarily found to exist and generally recognized as inherent in construction activities of the character provided for in the Contract Documents, the Contractor shall promptly provide notice to the Owner and the Architect before conditions are disturbed and in no event later than 14 days after first observance of the conditions. The Architect will promptly investigate such conditions and, if the Architect determines that they differ materially and cause an increase or decrease in the Contractor's cost of, or time required for, performance of any part of the Work, will recommend that an equitable adjustment be made in the Contract Sum or Contract Time, or both. If the Architect determines that the conditions at the site are not materially different from those indicated in the Contract Documents and that no change in the terms of the Contract is justified, the Architect shall promptly notify the Owner and Contractor, stating the reasons. If either party disputes the Architect's determination or recommendation, that party may submit a Claim as provided in Article 15.

§ 3.7.5 If, in the course of the Work, the Contractor encounters human remains or recognizes the existence of burial markers, archaeological sites or wetlands not indicated in the Contract Documents, the Contractor shall immediately suspend any operations that would affect them and shall notify the Owner and Architect. Upon receipt of such notice, the Owner shall promptly take any action necessary to obtain governmental authorization required to resume the operations. The Contractor shall continue to suspend such operations until otherwise instructed by the Owner but shall continue with all other operations that do not affect those remains or features. Requests for adjustments in the Contract Sum and Contract Time arising from the existence of such remains or features may be made as provided in Article 15.

§ 3.8 Allowances

§ 3.8.1 The Contractor shall include in the Contract Sum all allowances stated in the Contract Documents. Items covered by allowances shall be supplied for such amounts and by such persons or entities as the Owner may direct, but the Contractor shall not be required to employ persons or entities to whom the Contractor has reasonable objection.

§ 3.8.2 Unless otherwise provided in the Contract Documents,

- **.1** allowances shall cover the cost to the Contractor of materials and equipment delivered at the site and all required taxes, less applicable trade discounts;
- **.2** Contractor's costs for unloading and handling at the site, labor, installation costs, overhead, profit, and other expenses contemplated for stated allowance amounts shall be included in the Contract Sum but not in the allowances; and
- **.3** whenever costs are more than or less than allowances, the Contract Sum shall be adjusted accordingly by Change Order. The amount of the Change Order shall reflect (1) the difference between actual costs and the allowances under Section 3.8.2.1 and (2) changes in Contractor's costs under Section 3.8.2.2.

§ 3.8.3 Materials and equipment under an allowance shall be selected by the Owner with reasonable promptness.

§ 3.9 Superintendent

§ 3.9.1 The Contractor shall employ a competent superintendent and necessary assistants who shall be in attendance at the Project site during performance of the Work. The superintendent shall represent the Contractor, and communications given to the superintendent shall be as binding as if given to the Contractor.

§ 3.9.2 The Contractor, as soon as practicable after award of the Contract, shall notify the Owner and Architect of the name and qualifications of a proposed superintendent. Within 14 days of receipt of the information, the Architect may notify the Contractor, stating whether the Owner or the Architect (1) has reasonable objection to the proposed superintendent or (2) requires additional time for review. Failure of the Architect to provide notice within the 14-day period shall constitute notice of no reasonable objection.

§ 3.9.3 The Contractor shall not employ a proposed superintendent to whom the Owner or Architect has made reasonable and timely objection. The Contractor shall not change the superintendent without the Owner's consent, which shall not unreasonably be withheld or delayed.

§ 3.10 Contractor's Construction and Submittal Schedules

§ 3.10.1 The Contractor, promptly after being awarded the Contract, shall submit for the Owner's and Architect's information a Contractor's construction schedule for the Work. The schedule shall contain detail appropriate for the Project, including (1) the date of commencement of the Work, interim schedule milestone dates, and the date of Substantial Completion; (2) an apportionment of the Work by construction activity; and (3) the time required for completion of each portion of the Work. The schedule shall provide for the orderly progression of the Work to completion and shall not exceed time limits current under the Contract Documents. The schedule shall be revised at appropriate intervals as required by the conditions of the Work and Project.

§ 3.10.2 The Contractor, promptly after being awarded the Contract and thereafter as necessary to maintain a current submittal schedule, shall submit a submittal schedule for the Architect's approval. The Architect's approval shall not be unreasonably delayed or withheld. The submittal schedule shall (1) be coordinated with the Contractor's construction schedule, and (2) allow the Architect reasonable time to review submittals. If the Contractor fails to submit a submittal schedule, or fails to provide submittals in accordance with the approved submittal schedule, the Contractor shall not be entitled to any increase in Contract Sum or extension of Contract Time based on the time required for review of submittals.

§ 3.10.3 The Contractor shall perform the Work in general accordance with the most recent schedules submitted to the Owner and Architect.

§ 3.11 Documents and Samples at the Site

The Contractor shall make available, at the Project site, the Contract Documents, including Change Orders, Construction Change Directives, and other Modifications, in good order and marked currently to indicate field changes and selections made during construction, and the approved Shop Drawings, Product Data, Samples, and similar required submittals. These shall be in electronic form or paper copy, available to the Architect and Owner, and

delivered to the Architect for submittal to the Owner upon completion of the Work as a record of the Work as constructed.

§ 3.12 Shop Drawings, Product Data and Samples

§ 3.12.1 Shop Drawings are drawings, diagrams, schedules, and other data specially prepared for the Work by the Contractor or a Subcontractor, Sub-subcontractor, manufacturer, supplier, or distributor to illustrate some portion of the Work.

§ 3.12.2 Product Data are illustrations, standard schedules, performance charts, instructions, brochures, diagrams, and other information furnished by the Contractor to illustrate materials or equipment for some portion of the Work.

§ 3.12.3 Samples are physical examples that illustrate materials, equipment, or workmanship, and establish standards by which the Work will be judged.

§ 3.12.4 Shop Drawings, Product Data, Samples, and similar submittals are not Contract Documents. Their purpose is to demonstrate how the Contractor proposes to conform to the information given and the design concept expressed in the Contract Documents for those portions of the Work for which the Contract Documents require submittals. Review by the Architect is subject to the limitations of Section 4.2.7. Informational submittals upon which the Architect is not expected to take responsive action may be so identified in the Contract Documents. Submittals that are not required by the Contract Documents may be returned by the Architect without action.

§ 3.12.5 The Contractor shall review for compliance with the Contract Documents, approve, and submit to the Architect, Shop Drawings, Product Data, Samples, and similar submittals required by the Contract Documents, in accordance with the submittal schedule approved by the Architect or, in the absence of an approved submittal schedule, with reasonable promptness and in such sequence as to cause no delay in the Work or in the activities of the Owner or of Separate Contractors.

§ 3.12.6 By submitting Shop Drawings, Product Data, Samples, and similar submittals, the Contractor represents to the Owner and Architect that the Contractor has (1) reviewed and approved them, (2) determined and verified materials, field measurements and field construction criteria related thereto, or will do so, and (3) checked and coordinated the information contained within such submittals with the requirements of the Work and of the Contract Documents.

§ 3.12.7 The Contractor shall perform no portion of the Work for which the Contract Documents require submittal and review of Shop Drawings, Product Data, Samples, or similar submittals, until the respective submittal has been approved by the Architect.

§ 3.12.8 The Work shall be in accordance with approved submittals except that the Contractor shall not be relieved of responsibility for deviations from the requirements of the Contract Documents by the Architect's approval of Shop Drawings, Product Data, Samples, or similar submittals, unless the Contractor has specifically notified the Architect of such deviation at the time of submittal and (1) the Architect has given written approval to the specific deviation as a minor change in the Work, or (2) a Change Order or Construction Change Directive has been issued authorizing the deviation. The Contractor shall not be relieved of responsibility for errors or omissions in Shop Drawings, Product Data, Samples, or similar submittals, by the Architect's approval thereof.

§ 3.12.9 The Contractor shall direct specific attention, in writing or on resubmitted Shop Drawings, Product Data, Samples, or similar submittals, to revisions other than those requested by the Architect on previous submittals. In the absence of such notice, the Architect's approval of a resubmission shall not apply to such revisions.

§ 3.12.10 The Contractor shall not be required to provide professional services that constitute the practice of architecture or engineering unless such services are specifically required by the Contract Documents for a portion of the Work or unless the Contractor needs to provide such services in order to carry out the Contractor's responsibilities for construction means, methods, techniques, sequences, and procedures. The Contractor shall not be required to provide professional services in violation of applicable law.

§ 3.12.10.1 If professional design services or certifications by a design professional related to systems, materials, or equipment are specifically required of the Contractor by the Contract Documents, the Owner and the Architect will

specify all performance and design criteria that such services must satisfy. The Contractor shall be entitled to rely upon the adequacy and accuracy of the performance and design criteria provided in the Contract Documents. The Contractor shall cause such services or certifications to be provided by an appropriately licensed design professional, whose signature and seal shall appear on all drawings, calculations, specifications, certifications, Shop Drawings, and other submittals prepared by such professional. Shop Drawings, and other submittals related to the Work, designed or certified by such professional, if prepared by others, shall bear such professional's written approval when submitted to the Architect. The Owner and the Architect shall be entitled to rely upon the adequacy and accuracy of the services, certifications, and approvals performed or provided by such design professionals, provided the Owner and Architect have specified to the Contractor the performance and design criteria that such services must satisfy. Pursuant to this Section 3.12.10, the Architect will review and approve or take other appropriate action on submittals only for the limited purpose of checking for conformance with information given and the design concept expressed in the Contract Documents.

§ 3.12.10.2 If the Contract Documents require the Contractor's design professional to certify that the Work has been performed in accordance with the design criteria, the Contractor shall furnish such certifications to the Architect at the time and in the form specified by the Architect.

§ 3.13 Use of Site

The Contractor shall confine operations at the site to areas permitted by applicable laws, statutes, ordinances, codes, rules and regulations, lawful orders of public authorities, and the Contract Documents and shall not unreasonably encumber the site with materials or equipment.

§ 3.14 Cutting and Patching

§ 3.14.1 The Contractor shall be responsible for cutting, fitting, or patching required to complete the Work or to make its parts fit together properly. All areas requiring cutting, fitting, or patching shall be restored to the condition existing prior to the cutting, fitting, or patching, unless otherwise required by the Contract Documents.

§ 3.14.2 The Contractor shall not damage or endanger a portion of the Work or fully or partially completed construction of the Owner or Separate Contractors by cutting, patching, or otherwise altering such construction, or by excavation. The Contractor shall not cut or otherwise alter construction by the Owner or a Separate Contractor except with written consent of the Owner and of the Separate Contractor. Consent shall not be unreasonably withheld. The Contractor shall not unreasonably withhold, from the Owner or a Separate Contractor, its consent to cutting or otherwise altering the Work.

§ 3.15 Cleaning Up

§ 3.15.1 The Contractor shall keep the premises and surrounding area free from accumulation of waste materials and rubbish caused by operations under the Contract. At completion of the Work, the Contractor shall remove waste materials, rubbish, the Contractor's tools, construction equipment, machinery, and surplus materials from and about the Project.

§ 3.15.2 If the Contractor fails to clean up as provided in the Contract Documents, the Owner may do so and the Owner shall be entitled to reimbursement from the Contractor.

§ 3.16 Access to Work

The Contractor shall provide the Owner and Architect with access to the Work in preparation and progress wherever located.

§ 3.17 Royalties, Patents and Copyrights

The Contractor shall pay all royalties and license fees. The Contractor shall defend suits or claims for infringement of copyrights and patent rights and shall hold the Owner and Architect harmless from loss on account thereof, but shall not be responsible for defense or loss when a particular design, process, or product of a particular manufacturer or manufacturers is required by the Contract Documents, or where the copyright violations are contained in Drawings, Specifications, or other documents prepared by the Owner or Architect. However, if an infringement of a copyright or patent is discovered by, or made known to, the Contractor, the Contractor shall be responsible for the loss unless the information is promptly furnished to the Architect.

§ 3.18 Indemnification

§ 3.18.1 To the fullest extent permitted by law, the Contractor shall indemnify and hold harmless the Owner, Architect, Architect's consultants, and agents and employees of any of them from and against claims, damages, losses, and expenses, including but not limited to attorneys' fees, arising out of or resulting from performance of the Work, provided that such claim, damage, loss, or expense is attributable to bodily injury, sickness, disease or death, or to injury to or destruction of tangible property (other than the Work itself), but only to the extent caused by the negligent acts or omissions of the Contractor, a Subcontractor, anyone directly or indirectly employed by them, or anyone for whose acts they may be liable, regardless of whether or not such claim, damage, loss, or expense is caused in part by a party indemnified hereunder. Such obligation shall not be construed to negate, abridge, or reduce other rights or obligations of indemnity that would otherwise exist as to a party or person described in this Section 3.18.

§ 3.18.2 In claims against any person or entity indemnified under this Section 3.18 by an employee of the Contractor, a Subcontractor, anyone directly or indirectly employed by them, or anyone for whose acts they may be liable, the indemnification obligation under Section 3.18.1 shall not be limited by a limitation on amount or type of damages, compensation, or benefits payable by or for the Contractor or a Subcontractor under workers' compensation acts, disability benefit acts, or other employee benefit acts.

ARTICLE 4 ARCHITECT

§ 4.1 General

§ 4.1.1 The Architect is the person or entity retained by the Owner pursuant to Section 2.3.2 and identified as such in the Agreement.

§ 4.1.2 Duties, responsibilities, and limitations of authority of the Architect as set forth in the Contract Documents shall not be restricted, modified, or extended without written consent of the Owner, Contractor, and Architect. Consent shall not be unreasonably withheld.

§ 4.2 Administration of the Contract

§ 4.2.1 The Architect will provide administration of the Contract as described in the Contract Documents and will be an Owner's representative during construction until the date the Architect issues the final Certificate for Payment. The Architect will have authority to act on behalf of the Owner only to the extent provided in the Contract Documents.

§ 4.2.2 The Architect will visit the site at intervals appropriate to the stage of construction, or as otherwise agreed with the Owner, to become generally familiar with the progress and quality of the portion of the Work completed, and to determine in general if the Work observed is being performed in a manner indicating that the Work, when fully completed, will be in accordance with the Contract Documents. However, the Architect will not be required to make exhaustive or continuous on-site inspections to check the quality or quantity of the Work. The Architect will not have control over, charge of, or responsibility for the construction means, methods, techniques, sequences or procedures, or for the safety precautions and programs in connection with the Work, since these are solely the Contractor's rights and responsibilities under the Contract Documents.

§ 4.2.3 On the basis of the site visits, the Architect will keep the Owner reasonably informed about the progress and quality of the portion of the Work completed, and promptly report to the Owner (1) known deviations from the Contract Documents, (2) known deviations from the most recent construction schedule submitted by the Contractor, and (3) defects and deficiencies observed in the Work. The Architect will not be responsible for the Contractor's failure to perform the Work in accordance with the requirements of the Contract Documents. The Architect will not have control over or charge of, and will not be responsible for acts or omissions of, the Contractor, Subcontractors, or their agents or employees, or any other persons or entities performing portions of the Work.

§ 4.2.4 Communications

The Owner and Contractor shall include the Architect in all communications that relate to or affect the Architect's services or professional responsibilities. The Owner shall promptly notify the Architect of the substance of any direct communications between the Owner and the Contractor otherwise relating to the Project. Communications by and with the Architect's consultants shall be through the Architect. Communications by and with Subcontractors and suppliers shall be through the Contractor. Communications by and with Separate Contractors shall be through the Owner. The Contract Documents may specify other communication protocols.

§ 4.2.5 Based on the Architect's evaluations of the Contractor's Applications for Payment, the Architect will review and certify the amounts due the Contractor and will issue Certificates for Payment in such amounts.

§ 4.2.6 The Architect has authority to reject Work that does not conform to the Contract Documents. Whenever the Architect considers it necessary or advisable, the Architect will have authority to require inspection or testing of the Work in accordance with Sections 13.4.2 and 13.4.3, whether or not the Work is fabricated, installed or completed. However, neither this authority of the Architect nor a decision made in good faith either to exercise or not to exercise such authority shall give rise to a duty or responsibility of the Architect to the Contractor, Subcontractors, suppliers, their agents or employees, or other persons or entities performing portions of the Work.

§ 4.2.7 The Architect will review and approve, or take other appropriate action upon, the Contractor's submittals such as Shop Drawings, Product Data, and Samples, but only for the limited purpose of checking for conformance with information given and the design concept expressed in the Contract Documents. The Architect's action will be taken in accordance with the submittal schedule approved by the Architect or, in the absence of an approved submittal schedule, with reasonable promptness while allowing sufficient time in the Architect's professional judgment to permit adequate review. Review of such submittals is not conducted for the purpose of determining the accuracy and completeness of other details such as dimensions and quantities, or for substantiating instructions for installation or performance of equipment or systems, all of which remain the responsibility of the Contractor as required by the Contract Documents. The Architect's review of the Contractor's submittals shall not relieve the Contractor of the obligations under Sections 3.3, 3.5, and 3.12. The Architect's review shall not constitute approval of safety precautions or of any construction means, methods, techniques, sequences, or procedures. The Architect's approval of a specific item shall not indicate approval of an assembly of which the item is a component.

§ 4.2.8 The Architect will prepare Change Orders and Construction Change Directives, and may order minor changes in the Work as provided in Section 7.4. The Architect will investigate and make determinations and recommendations regarding concealed and unknown conditions as provided in Section 3.7.4.

§ 4.2.9 The Architect will conduct inspections to determine the date or dates of Substantial Completion and the date of final completion; issue Certificates of Substantial Completion pursuant to Section 9.8; receive and forward to the Owner, for the Owner's review and records, written warranties and related documents required by the Contract and assembled by the Contractor pursuant to Section 9.10; and issue a final Certificate for Payment pursuant to Section 9.10.

§ 4.2.10 If the Owner and Architect agree, the Architect will provide one or more Project representatives to assist in carrying out the Architect's responsibilities at the site. The Owner shall notify the Contractor of any change in the duties, responsibilities and limitations of authority of the Project representatives.

§ 4.2.11 The Architect will interpret and decide matters concerning performance under, and requirements of, the Contract Documents on written request of either the Owner or Contractor. The Architect's response to such requests will be made in writing within any time limits agreed upon or otherwise with reasonable promptness.

§ 4.2.12 Interpretations and decisions of the Architect will be consistent with the intent of, and reasonably inferable from, the Contract Documents and will be in writing or in the form of drawings. When making such interpretations and decisions, the Architect will endeavor to secure faithful performance by both Owner and Contractor, will not show partiality to either, and will not be liable for results of interpretations or decisions rendered in good faith.

§ 4.2.13 The Architect's decisions on matters relating to aesthetic effect will be final if consistent with the intent expressed in the Contract Documents.

§ 4.2.14 The Architect will review and respond to requests for information about the Contract Documents. The Architect's response to such requests will be made in writing within any time limits agreed upon or otherwise with reasonable promptness. If appropriate, the Architect will prepare and issue supplemental Drawings and Specifications in response to the requests for information.

ARTICLE 5 SUBCONTRACTORS

§ 5.1 Definitions

§ 5.1.1 A Subcontractor is a person or entity who has a direct contract with the Contractor to perform a portion of the Work at the site. The term "Subcontractor" is referred to throughout the Contract Documents as if singular in number and means a Subcontractor or an authorized representative of the Subcontractor. The term "Subcontractor" does not include a Separate Contractor or the subcontractors of a Separate Contractor.

§ 5.1.2 A Sub-subcontractor is a person or entity who has a direct or indirect contract with a Subcontractor to perform a portion of the Work at the site. The term "Sub-subcontractor" is referred to throughout the Contract Documents as if singular in number and means a Sub-subcontractor or an authorized representative of the Sub-subcontractor.

§ 5.2 Award of Subcontracts and Other Contracts for Portions of the Work

§ 5.2.1 Unless otherwise stated in the Contract Documents, the Contractor, as soon as practicable after award of the Contract, shall notify the Owner and Architect of the persons or entities proposed for each principal portion of the Work, including those who are to furnish materials or equipment fabricated to a special design. Within 14 days of receipt of the information, the Architect may notify the Contractor whether the Owner or the Architect (1) has reasonable objection to any such proposed person or entity or (2) requires additional time for review. Failure of the Architect to provide notice within the 14-day period shall constitute notice of no reasonable objection.

§ 5.2.2 The Contractor shall not contract with a proposed person or entity to whom the Owner or Architect has made reasonable and timely objection. The Contractor shall not be required to contract with anyone to whom the Contractor has made reasonable objection.

§ 5.2.3 If the Owner or Architect has reasonable objection to a person or entity proposed by the Contractor, the Contractor shall propose another to whom the Owner or Architect has no reasonable objection. If the proposed but rejected Subcontractor was reasonably capable of performing the Work, the Contract Sum and Contract Time shall be increased or decreased by the difference, if any, occasioned by such change, and an appropriate Change Order shall be issued before commencement of the substitute Subcontractor's Work. However, no increase in the Contract Sum or Contract Time shall be allowed for such change unless the Contractor has acted promptly and responsively in submitting names as required.

§ 5.2.4 The Contractor shall not substitute a Subcontractor, person, or entity for one previously selected if the Owner or Architect makes reasonable objection to such substitution.

§ 5.3 Subcontractual Relations

By appropriate written agreement, the Contractor shall require each Subcontractor, to the extent of the Work to be performed by the Subcontractor, to be bound to the Contractor by terms of the Contract Documents, and to assume toward the Contractor all the obligations and responsibilities, including the responsibility for safety of the Subcontractor's Work that the Contractor, by these Contract Documents, assumes toward the Owner and Architect. Each subcontract agreement shall preserve and protect the rights of the Owner and Architect under the Contract Documents with respect to the Work to be performed by the Subcontractor so that subcontracting thereof will not prejudice such rights, and shall allow to the Subcontractor, unless specifically provided otherwise in the subcontract agreement, the benefit of all rights, remedies, and redress against the Contractor that the Contractor, by the Contract Documents, has against the Owner. Where appropriate, the Contractor shall require each Subcontractor to enter into similar agreements with Sub-subcontractors. The Contractor shall make available to each proposed Subcontractor, prior to the execution of the subcontract agreement, copies of the Contract Documents to which the Subcontractor will be bound, and, upon written request of the Subcontractor, identify to the Subcontractor terms and conditions of the proposed subcontract agreement that may be at variance with the Contract Documents. Subcontractors will similarly make copies of applicable portions of such documents available to their respective proposed Sub-subcontractors.

§ 5.4 Contingent Assignment of Subcontracts

§ 5.4.1 Each subcontract agreement for a portion of the Work is assigned by the Contractor to the Owner, provided that

- **.1** assignment is effective only after termination of the Contract by the Owner for cause pursuant to Section 14.2 and only for those subcontract agreements that the Owner accepts by notifying the Subcontractor and Contractor; and
- **.2** assignment is subject to the prior rights of the surety, if any, obligated under bond relating to the Contract.

When the Owner accepts the assignment of a subcontract agreement, the Owner assumes the Contractor's rights and obligations under the subcontract.

§ 5.4.2 Upon such assignment, if the Work has been suspended for more than 30 days, the Subcontractor's compensation shall be equitably adjusted for increases in cost resulting from the suspension.

§ 5.4.3 Upon assignment to the Owner under this Section 5.4, the Owner may further assign the subcontract to a successor contractor or other entity. If the Owner assigns the subcontract to a successor contractor or other entity, the Owner shall nevertheless remain legally responsible for all of the successor contractor's obligations under the subcontract.

ARTICLE 6 CONSTRUCTION BY OWNER OR BY SEPARATE CONTRACTORS

§ 6.1 Owner's Right to Perform Construction and to Award Separate Contracts

§ 6.1.1 The term "Separate Contractor(s)" shall mean other contractors retained by the Owner under separate agreements. The Owner reserves the right to perform construction or operations related to the Project with the Owner's own forces, and with Separate Contractors retained under Conditions of the Contract substantially similar to those of this Contract, including those provisions of the Conditions of the Contract related to insurance and waiver of subrogation.

§ 6.1.2 When separate contracts are awarded for different portions of the Project or other construction or operations on the site, the term "Contractor" in the Contract Documents in each case shall mean the Contractor who executes each separate Owner-Contractor Agreement.

§ 6.1.3 The Owner shall provide for coordination of the activities of the Owner's own forces and of each Separate Contractor with the Work of the Contractor, who shall cooperate with them. The Contractor shall participate with any Separate Contractors and the Owner in reviewing their construction schedules. The Contractor shall make any revisions to its construction schedule deemed necessary after a joint review and mutual agreement. The construction schedules shall then constitute the schedules to be used by the Contractor, Separate Contractors, and the Owner until subsequently revised.

§ 6.1.4 Unless otherwise provided in the Contract Documents, when the Owner performs construction or operations related to the Project with the Owner's own forces or with Separate Contractors, the Owner or its Separate Contractors shall have the same obligations and rights that the Contractor has under the Conditions of the Contract, including, without excluding others, those stated in Article 3, this Article 6, and Articles 10, 11, and 12.

§ 6.2 Mutual Responsibility

§ 6.2.1 The Contractor shall afford the Owner and Separate Contractors reasonable opportunity for introduction and storage of their materials and equipment and performance of their activities, and shall connect and coordinate the Contractor's construction and operations with theirs as required by the Contract Documents.

§ 6.2.2 If part of the Contractor's Work depends for proper execution or results upon construction or operations by the Owner or a Separate Contractor, the Contractor shall, prior to proceeding with that portion of the Work, promptly notify the Architect of apparent discrepancies or defects in the construction or operations by the Owner or Separate Contractor that would render it unsuitable for proper execution and results of the Contractor's Work. Failure of the Contractor to notify the Architect of apparent discrepancies or defects prior to proceeding with the Work shall constitute an acknowledgment that the Owner's or Separate Contractor's completed or partially completed construction is fit and proper to receive the Contractor's Work. The Contractor shall not be responsible for discrepancies or defects in the construction or operations by the Owner or Separate Contractor that are not apparent.

§ 6.2.3 The Contractor shall reimburse the Owner for costs the Owner incurs that are payable to a Separate Contractor because of the Contractor's delays, improperly timed activities or defective construction. The Owner shall be responsible to the Contractor for costs the Contractor incurs because of a Separate Contractor's delays, improperly timed activities, damage to the Work or defective construction.

§ 6.2.4 The Contractor shall promptly remedy damage that the Contractor wrongfully causes to completed or partially completed construction or to property of the Owner or Separate Contractor as provided in Section 10.2.5.

§ 6.2.5 The Owner and each Separate Contractor shall have the same responsibilities for cutting and patching as are described for the Contractor in Section 3.14.

§ 6.3 Owner's Right to Clean Up

If a dispute arises among the Contractor, Separate Contractors, and the Owner as to the responsibility under their respective contracts for maintaining the premises and surrounding area free from waste materials and rubbish, the Owner may clean up and the Architect will allocate the cost among those responsible.

ARTICLE 7 CHANGES IN THE WORK

§ 7.1 General

§ 7.1.1 Changes in the Work may be accomplished after execution of the Contract, and without invalidating the Contract, by Change Order, Construction Change Directive or order for a minor change in the Work, subject to the limitations stated in this Article 7 and elsewhere in the Contract Documents.

§ 7.1.2 A Change Order shall be based upon agreement among the Owner, Contractor, and Architect. A Construction Change Directive requires agreement by the Owner and Architect and may or may not be agreed to by the Contractor. An order for a minor change in the Work may be issued by the Architect alone.

§ 7.1.3 Changes in the Work shall be performed under applicable provisions of the Contract Documents. The Contractor shall proceed promptly with changes in the Work, unless otherwise provided in the Change Order, Construction Change Directive, or order for a minor change in the Work.

§ 7.2 Change Orders

§ 7.2.1 A Change Order is a written instrument prepared by the Architect and signed by the Owner, Contractor, and Architect stating their agreement upon all of the following:

- **.1** The change in the Work;
- **.2** The amount of the adjustment, if any, in the Contract Sum; and
- **.3** The extent of the adjustment, if any, in the Contract Time.

§ 7.3 Construction Change Directives

§ 7.3.1 A Construction Change Directive is a written order prepared by the Architect and signed by the Owner and Architect, directing a change in the Work prior to agreement on adjustment, if any, in the Contract Sum or Contract Time, or both. The Owner may by Construction Change Directive, without invalidating the Contract, order changes in the Work within the general scope of the Contract consisting of additions, deletions, or other revisions, the Contract Sum and Contract Time being adjusted accordingly.

§ 7.3.2 A Construction Change Directive shall be used in the absence of total agreement on the terms of a Change Order.

§ 7.3.3 If the Construction Change Directive provides for an adjustment to the Contract Sum, the adjustment shall be based on one of the following methods:

- **.1** Mutual acceptance of a lump sum properly itemized and supported by sufficient substantiating data to permit evaluation;
- **.2** Unit prices stated in the Contract Documents or subsequently agreed upon;
- **.3** Cost to be determined in a manner agreed upon by the parties and a mutually acceptable fixed or percentage fee; or
- **.4** As provided in Section 7.3.4.

§ 7.3.4 If the Contractor does not respond promptly or disagrees with the method for adjustment in the Contract Sum, the Architect shall determine the adjustment on the basis of reasonable expenditures and savings of those performing the Work attributable to the change, including, in case of an increase in the Contract Sum, an amount for overhead and profit as set forth in the Agreement, or if no such amount is set forth in the Agreement, a reasonable amount. In such case, and also under Section 7.3.3.3, the Contractor shall keep and present, in such form as the Architect may prescribe, an itemized accounting together with appropriate supporting data. Unless otherwise provided in the Contract Documents, costs for the purposes of this Section 7.3.4 shall be limited to the following:

.1 Costs of labor, including applicable payroll taxes, fringe benefits required by agreement or custom, workers' compensation insurance, and other employee costs approved by the Architect;

.2 Costs of materials, supplies, and equipment, including cost of transportation, whether incorporated or consumed;

.3 Rental costs of machinery and equipment, exclusive of hand tools, whether rented from the Contractor or others;

.4 Costs of premiums for all bonds and insurance, permit fees, and sales, use, or similar taxes, directly related to the change; and

.5 Costs of supervision and field office personnel directly attributable to the change.

§ 7.3.5 If the Contractor disagrees with the adjustment in the Contract Time, the Contractor may make a Claim in accordance with applicable provisions of Article 15.

§ 7.3.6 Upon receipt of a Construction Change Directive, the Contractor shall promptly proceed with the change in the Work involved and advise the Architect of the Contractor's agreement or disagreement with the method, if any, provided in the Construction Change Directive for determining the proposed adjustment in the Contract Sum or Contract Time.

§ 7.3.7 A Construction Change Directive signed by the Contractor indicates the Contractor's agreement therewith, including adjustment in Contract Sum and Contract Time or the method for determining them. Such agreement shall be effective immediately and shall be recorded as a Change Order.

§ 7.3.8 The amount of credit to be allowed by the Contractor to the Owner for a deletion or change that results in a net decrease in the Contract Sum shall be actual net cost as confirmed by the Architect. When both additions and credits covering related Work or substitutions are involved in a change, the allowance for overhead and profit shall be figured on the basis of net increase, if any, with respect to that change.

§ 7.3.9 Pending final determination of the total cost of a Construction Change Directive to the Owner, the Contractor may request payment for Work completed under the Construction Change Directive in Applications for Payment. The Architect will make an interim determination for purposes of monthly certification for payment for those costs and certify for payment the amount that the Architect determines, in the Architect's professional judgment, to be reasonably justified. The Architect's interim determination of cost shall adjust the Contract Sum on the same basis as a Change Order, subject to the right of either party to disagree and assert a Claim in accordance with Article 15.

§ 7.3.10 When the Owner and Contractor agree with a determination made by the Architect concerning the adjustments in the Contract Sum and Contract Time, or otherwise reach agreement upon the adjustments, such agreement shall be effective immediately and the Architect will prepare a Change Order. Change Orders may be issued for all or any part of a Construction Change Directive.

§ 7.4 Minor Changes in the Work

The Architect may order minor changes in the Work that are consistent with the intent of the Contract Documents and do not involve an adjustment in the Contract Sum or an extension of the Contract Time. The Architect's order for minor changes shall be in writing. If the Contractor believes that the proposed minor change in the Work will affect the Contract Sum or Contract Time, the Contractor shall notify the Architect and shall not proceed to implement the change in the Work. If the Contractor performs the Work set forth in the Architect's order for a minor change without prior notice to the Architect that such change will affect the Contract Sum or Contract Time, the Contractor waives any adjustment to the Contract Sum or extension of the Contract Time.

ARTICLE 8 TIME

§ 8.1 Definitions

§ 8.1.1 Unless otherwise provided, Contract Time is the period of time, including authorized adjustments, allotted in the Contract Documents for Substantial Completion of the Work.

§ 8.1.2 The date of commencement of the Work is the date established in the Agreement.

§ 8.1.3 The date of Substantial Completion is the date certified by the Architect in accordance with Section 9.8.

§ 8.1.4 The term "day" as used in the Contract Documents shall mean calendar day unless otherwise specifically defined.

§ 8.2 Progress and Completion

§ 8.2.1 Time limits stated in the Contract Documents are of the essence of the Contract. By executing the Agreement, the Contractor confirms that the Contract Time is a reasonable period for performing the Work.

§ 8.2.2 The Contractor shall not knowingly, except by agreement or instruction of the Owner in writing, commence the Work prior to the effective date of insurance required to be furnished by the Contractor and Owner.

§ 8.2.3 The Contractor shall proceed expeditiously with adequate forces and shall achieve Substantial Completion within the Contract Time.

§ 8.3 Delays and Extensions of Time

§ 8.3.1 If the Contractor is delayed at any time in the commencement or progress of the Work by (1) an act or neglect of the Owner or Architect, of an employee of either, or of a Separate Contractor; (2) by changes ordered in the Work; (3) by labor disputes, fire, unusual delay in deliveries, unavoidable casualties, adverse weather conditions documented in accordance with Section 15.1.6.2, or other causes beyond the Contractor's control; (4) by delay authorized by the Owner pending mediation and binding dispute resolution; or (5) by other causes that the Contractor asserts, and the Architect determines, justify delay, then the Contract Time shall be extended for such reasonable time as the Architect may determine.

§ 8.3.2 Claims relating to time shall be made in accordance with applicable provisions of Article 15.

§ 8.3.3 This Section 8.3 does not preclude recovery of damages for delay by either party under other provisions of the Contract Documents.

ARTICLE 9 PAYMENTS AND COMPLETION

§ 9.1 Contract Sum

§ 9.1.1 The Contract Sum is stated in the Agreement and, including authorized adjustments, is the total amount payable by the Owner to the Contractor for performance of the Work under the Contract Documents.

§ 9.1.2 If unit prices are stated in the Contract Documents or subsequently agreed upon, and if quantities originally contemplated are materially changed so that application of such unit prices to the actual quantities causes substantial inequity to the Owner or Contractor, the applicable unit prices shall be equitably adjusted.

§ 9.2 Schedule of Values

Where the Contract is based on a stipulated sum or Guaranteed Maximum Price, the Contractor shall submit a schedule of values to the Architect before the first Application for Payment, allocating the entire Contract Sum to the various portions of the Work. The schedule of values shall be prepared in the form, and supported by the data to substantiate its accuracy, required by the Architect. This schedule, unless objected to by the Architect, shall be used as a basis for reviewing the Contractor's Applications for Payment. Any changes to the schedule of values shall be submitted to the Architect and supported by such data to substantiate its accuracy as the Architect may require, and unless objected to by the Architect, shall be used as a basis for reviewing the Contractor's subsequent Applications for Payment.

§ 9.3 Applications for Payment

§ 9.3.1 At least ten days before the date established for each progress payment, the Contractor shall submit to the Architect an itemized Application for Payment prepared in accordance with the schedule of values, if required under Section 9.2, for completed portions of the Work. The application shall be notarized, if required, and supported by all data substantiating the Contractor's right to payment that the Owner or Architect require, such as copies of requisitions, and releases and waivers of liens from Subcontractors and suppliers, and shall reflect retainage if provided for in the Contract Documents.

§ 9.3.1.1 As provided in Section 7.3.9, such applications may include requests for payment on account of changes in the Work that have been properly authorized by Construction Change Directives, or by interim determinations of the Architect, but not yet included in Change Orders.

§ 9.3.1.2 Applications for Payment shall not include requests for payment for portions of the Work for which the Contractor does not intend to pay a Subcontractor or supplier, unless such Work has been performed by others whom the Contractor intends to pay.

§ 9.3.2 Unless otherwise provided in the Contract Documents, payments shall be made on account of materials and equipment delivered and suitably stored at the site for subsequent incorporation in the Work. If approved in advance by the Owner, payment may similarly be made for materials and equipment suitably stored off the site at a location agreed upon in writing. Payment for materials and equipment stored on or off the site shall be conditioned upon compliance by the Contractor with procedures satisfactory to the Owner to establish the Owner's title to such materials and equipment or otherwise protect the Owner's interest, and shall include the costs of applicable insurance, storage, and transportation to the site, for such materials and equipment stored off the site.

§ 9.3.3 The Contractor warrants that title to all Work covered by an Application for Payment will pass to the Owner no later than the time of payment. The Contractor further warrants that upon submittal of an Application for Payment all Work for which Certificates for Payment have been previously issued and payments received from the Owner shall, to the best of the Contractor's knowledge, information, and belief, be free and clear of liens, claims, security interests, or encumbrances, in favor of the Contractor, Subcontractors, suppliers, or other persons or entities that provided labor, materials, and equipment relating to the Work.

§ 9.4 Certificates for Payment

§ 9.4.1 The Architect will, within seven days after receipt of the Contractor's Application for Payment, either (1) issue to the Owner a Certificate for Payment in the full amount of the Application for Payment, with a copy to the Contractor; or (2) issue to the Owner a Certificate for Payment for such amount as the Architect determines is properly due, and notify the Contractor and Owner of the Architect's reasons for withholding certification in part as provided in Section 9.5.1; or (3) withhold certification of the entire Application for Payment, and notify the Contractor and Owner of the Architect's reason for withholding certification in whole as provided in Section 9.5.1.

§ 9.4.2 The issuance of a Certificate for Payment will constitute a representation by the Architect to the Owner, based on the Architect's evaluation of the Work and the data in the Application for Payment, that, to the best of the Architect's knowledge, information, and belief, the Work has progressed to the point indicated, the quality of the Work is in accordance with the Contract Documents, and that the Contractor is entitled to payment in the amount certified. The foregoing representations are subject to an evaluation of the Work for conformance with the Contract Documents upon Substantial Completion, to results of subsequent tests and inspections, to correction of minor deviations from the Contract Documents prior to completion, and to specific qualifications expressed by the Architect. However, the issuance of a Certificate for Payment will not be a representation that the Architect has (1) made exhaustive or continuous on-site inspections to check the quality or quantity of the Work; (2) reviewed construction means, methods, techniques, sequences, or procedures; (3) reviewed copies of requisitions received from Subcontractors and suppliers and other data requested by the Owner to substantiate the Contractor's right to payment; or (4) made examination to ascertain how or for what purpose the Contractor has used money previously paid on account of the Contract Sum.

§ 9.5 Decisions to Withhold Certification

§ 9.5.1 The Architect may withhold a Certificate for Payment in whole or in part, to the extent reasonably necessary to protect the Owner, if in the Architect's opinion the representations to the Owner required by Section 9.4.2 cannot be made. If the Architect is unable to certify payment in the amount of the Application, the Architect will notify the Contractor and Owner as provided in Section 9.4.1. If the Contractor and Architect cannot agree on a revised amount, the Architect will promptly issue a Certificate for Payment for the amount for which the Architect is able to make such representations to the Owner. The Architect may also withhold a Certificate for Payment or, because of subsequently discovered evidence, may nullify the whole or a part of a Certificate for Payment previously issued, to such extent as may be necessary in the Architect's opinion to protect the Owner from loss for which the Contractor is responsible, including loss resulting from acts and omissions described in Section 3.3.2, because of

- **.1** defective Work not remedied;
- **.2** third party claims filed or reasonable evidence indicating probable filing of such claims, unless security acceptable to the Owner is provided by the Contractor;
- **.3** failure of the Contractor to make payments properly to Subcontractors or suppliers for labor, materials or equipment;

.4 reasonable evidence that the Work cannot be completed for the unpaid balance of the Contract Sum;
.5 damage to the Owner or a Separate Contractor;
.6 reasonable evidence that the Work will not be completed within the Contract Time, and that the unpaid balance would not be adequate to cover actual or liquidated damages for the anticipated delay; or
.7 repeated failure to carry out the Work in accordance with the Contract Documents.

§ 9.5.2 When either party disputes the Architect's decision regarding a Certificate for Payment under Section 9.5.1, in whole or in part, that party may submit a Claim in accordance with Article 15.

§ 9.5.3 When the reasons for withholding certification are removed, certification will be made for amounts previously withheld.

§ 9.5.4 If the Architect withholds certification for payment under Section 9.5.1.3, the Owner may, at its sole option, issue joint checks to the Contractor and to any Subcontractor or supplier to whom the Contractor failed to make payment for Work properly performed or material or equipment suitably delivered. If the Owner makes payments by joint check, the Owner shall notify the Architect and the Contractor shall reflect such payment on its next Application for Payment.

§ 9.6 Progress Payments

§ 9.6.1 After the Architect has issued a Certificate for Payment, the Owner shall make payment in the manner and within the time provided in the Contract Documents, and shall so notify the Architect.

§ 9.6.2 The Contractor shall pay each Subcontractor, no later than seven days after receipt of payment from the Owner, the amount to which the Subcontractor is entitled, reflecting percentages actually retained from payments to the Contractor on account of the Subcontractor's portion of the Work. The Contractor shall, by appropriate agreement with each Subcontractor, require each Subcontractor to make payments to Sub-subcontractors in a similar manner.

§ 9.6.3 The Architect will, on request, furnish to a Subcontractor, if practicable, information regarding percentages of completion or amounts applied for by the Contractor and action taken thereon by the Architect and Owner on account of portions of the Work done by such Subcontractor.

§ 9.6.4 The Owner has the right to request written evidence from the Contractor that the Contractor has properly paid Subcontractors and suppliers amounts paid by the Owner to the Contractor for subcontracted Work. If the Contractor fails to furnish such evidence within seven days, the Owner shall have the right to contact Subcontractors and suppliers to ascertain whether they have been properly paid. Neither the Owner nor Architect shall have an obligation to pay, or to see to the payment of money to, a Subcontractor or supplier, except as may otherwise be required by law.

§ 9.6.5 The Contractor's payments to suppliers shall be treated in a manner similar to that provided in Sections 9.6.2, 9.6.3 and 9.6.4.

§ 9.6.6 A Certificate for Payment, a progress payment, or partial or entire use or occupancy of the Project by the Owner shall not constitute acceptance of Work not in accordance with the Contract Documents.

§ 9.6.7 Unless the Contractor provides the Owner with a payment bond in the full penal sum of the Contract Sum, payments received by the Contractor for Work properly performed by Subcontractors or provided by suppliers shall be held by the Contractor for those Subcontractors or suppliers who performed Work or furnished materials, or both, under contract with the Contractor for which payment was made by the Owner. Nothing contained herein shall require money to be placed in a separate account and not commingled with money of the Contractor, create any fiduciary liability or tort liability on the part of the Contractor for breach of trust, or entitle any person or entity to an award of punitive damages against the Contractor for breach of the requirements of this provision.

§ 9.6.8 Provided the Owner has fulfilled its payment obligations under the Contract Documents, the Contractor shall defend and indemnify the Owner from all loss, liability, damage or expense, including reasonable attorney's fees and litigation expenses, arising out of any lien claim or other claim for payment by any Subcontractor or supplier of any tier. Upon receipt of notice of a lien claim or other claim for payment, the Owner shall notify the Contractor. If approved by the applicable court, when required, the Contractor may substitute a surety bond for the property against which the lien or other claim for payment has been asserted.

§ 9.7 Failure of Payment

If the Architect does not issue a Certificate for Payment, through no fault of the Contractor, within seven days after receipt of the Contractor's Application for Payment, or if the Owner does not pay the Contractor within seven days after the date established in the Contract Documents, the amount certified by the Architect or awarded by binding dispute resolution, then the Contractor may, upon seven additional days' notice to the Owner and Architect, stop the Work until payment of the amount owing has been received. The Contract Time shall be extended appropriately and the Contract Sum shall be increased by the amount of the Contractor's reasonable costs of shutdown, delay and start-up, plus interest as provided for in the Contract Documents.

§ 9.8 Substantial Completion

§ 9.8.1 Substantial Completion is the stage in the progress of the Work when the Work or designated portion thereof is sufficiently complete in accordance with the Contract Documents so that the Owner can occupy or utilize the Work for its intended use.

§ 9.8.2 When the Contractor considers that the Work, or a portion thereof which the Owner agrees to accept separately, is substantially complete, the Contractor shall prepare and submit to the Architect a comprehensive list of items to be completed or corrected prior to final payment. Failure to include an item on such list does not alter the responsibility of the Contractor to complete all Work in accordance with the Contract Documents.

§ 9.8.3 Upon receipt of the Contractor's list, the Architect will make an inspection to determine whether the Work or designated portion thereof is substantially complete. If the Architect's inspection discloses any item, whether or not included on the Contractor's list, which is not sufficiently complete in accordance with the Contract Documents so that the Owner can occupy or utilize the Work or designated portion thereof for its intended use, the Contractor shall, before issuance of the Certificate of Substantial Completion, complete or correct such item upon notification by the Architect. In such case, the Contractor shall then submit a request for another inspection by the Architect to determine Substantial Completion.

§ 9.8.4 When the Work or designated portion thereof is substantially complete, the Architect will prepare a Certificate of Substantial Completion that shall establish the date of Substantial Completion; establish responsibilities of the Owner and Contractor for security, maintenance, heat, utilities, damage to the Work and insurance; and fix the time within which the Contractor shall finish all items on the list accompanying the Certificate. Warranties required by the Contract Documents shall commence on the date of Substantial Completion of the Work or designated portion thereof unless otherwise provided in the Certificate of Substantial Completion.

§ 9.8.5 The Certificate of Substantial Completion shall be submitted to the Owner and Contractor for their written acceptance of responsibilities assigned to them in the Certificate. Upon such acceptance, and consent of surety if any, the Owner shall make payment of retainage applying to the Work or designated portion thereof. Such payment shall be adjusted for Work that is incomplete or not in accordance with the requirements of the Contract Documents.

§ 9.9 Partial Occupancy or Use

§ 9.9.1 The Owner may occupy or use any completed or partially completed portion of the Work at any stage when such portion is designated by separate agreement with the Contractor, provided such occupancy or use is consented to by the insurer and authorized by public authorities having jurisdiction over the Project. Such partial occupancy or use may commence whether or not the portion is substantially complete, provided the Owner and Contractor have accepted in writing the responsibilities assigned to each of them for payments, retainage, if any, security, maintenance, heat, utilities, damage to the Work and insurance, and have agreed in writing concerning the period for correction of the Work and commencement of warranties required by the Contract Documents. When the Contractor considers a portion substantially complete, the Contractor shall prepare and submit a list to the Architect as provided under Section 9.8.2. Consent of the Contractor to partial occupancy or use shall not be unreasonably withheld. The stage of the progress of the Work shall be determined by written agreement between the Owner and Contractor or, if no agreement is reached, by decision of the Architect.

§ 9.9.2 Immediately prior to such partial occupancy or use, the Owner, Contractor, and Architect shall jointly inspect the area to be occupied or portion of the Work to be used in order to determine and record the condition of the Work.

§ 9.9.3 Unless otherwise agreed upon, partial occupancy or use of a portion or portions of the Work shall not constitute acceptance of Work not complying with the requirements of the Contract Documents.

§ 9.10 Final Completion and Final Payment

§ 9.10.1 Upon receipt of the Contractor's notice that the Work is ready for final inspection and acceptance and upon receipt of a final Application for Payment, the Architect will promptly make such inspection. When the Architect finds the Work acceptable under the Contract Documents and the Contract fully performed, the Architect will promptly issue a final Certificate for Payment stating that to the best of the Architect's knowledge, information and belief, and on the basis of the Architect's on-site visits and inspections, the Work has been completed in accordance with the Contract Documents and that the entire balance found to be due the Contractor and noted in the final Certificate is due and payable. The Architect's final Certificate for Payment will constitute a further representation that conditions listed in Section 9.10.2 as precedent to the Contractor's being entitled to final payment have been fulfilled.

§ 9.10.2 Neither final payment nor any remaining retained percentage shall become due until the Contractor submits to the Architect (1) an affidavit that payrolls, bills for materials and equipment, and other indebtedness connected with the Work for which the Owner or the Owner's property might be responsible or encumbered (less amounts withheld by Owner) have been paid or otherwise satisfied, (2) a certificate evidencing that insurance required by the Contract Documents to remain in force after final payment is currently in effect, (3) a written statement that the Contractor knows of no reason that the insurance will not be renewable to cover the period required by the Contract Documents, (4) consent of surety, if any, to final payment, (5) documentation of any special warranties, such as manufacturers' warranties or specific Subcontractor warranties, and (6) if required by the Owner, other data establishing payment or satisfaction of obligations, such as receipts and releases and waivers of liens, claims, security interests, or encumbrances arising out of the Contract, to the extent and in such form as may be designated by the Owner. If a Subcontractor refuses to furnish a release or waiver required by the Owner, the Contractor may furnish a bond satisfactory to the Owner to indemnify the Owner against such lien, claim, security interest, or encumbrance. If a lien, claim, security interest, or encumbrance remains unsatisfied after payments are made, the Contractor shall refund to the Owner all money that the Owner may be compelled to pay in discharging the lien, claim, security interest, or encumbrance, including all costs and reasonable attorneys' fees.

§ 9.10.3 If, after Substantial Completion of the Work, final completion thereof is materially delayed through no fault of the Contractor or by issuance of Change Orders affecting final completion, and the Architect so confirms, the Owner shall, upon application by the Contractor and certification by the Architect, and without terminating the Contract, make payment of the balance due for that portion of the Work fully completed, corrected, and accepted. If the remaining balance for Work not fully completed or corrected is less than retainage stipulated in the Contract Documents, and if bonds have been furnished, the written consent of the surety to payment of the balance due for that portion of the Work fully completed and accepted shall be submitted by the Contractor to the Architect prior to certification of such payment. Such payment shall be made under terms and conditions governing final payment, except that it shall not constitute a waiver of Claims.

§ 9.10.4 The making of final payment shall constitute a waiver of Claims by the Owner except those arising from

- **.1** liens, Claims, security interests, or encumbrances arising out of the Contract and unsettled;
- **.2** failure of the Work to comply with the requirements of the Contract Documents;
- **.3** terms of special warranties required by the Contract Documents; or
- **.4** audits performed by the Owner, if permitted by the Contract Documents, after final payment.

§ 9.10.5 Acceptance of final payment by the Contractor, a Subcontractor, or a supplier, shall constitute a waiver of claims by that payee except those previously made in writing and identified by that payee as unsettled at the time of final Application for Payment.

ARTICLE 10 PROTECTION OF PERSONS AND PROPERTY

§ 10.1 Safety Precautions and Programs

The Contractor shall be responsible for initiating, maintaining, and supervising all safety precautions and programs in connection with the performance of the Contract.

§ 10.2 Safety of Persons and Property

§ 10.2.1 The Contractor shall take reasonable precautions for safety of, and shall provide reasonable protection to prevent damage, injury, or loss to

.1 employees on the Work and other persons who may be affected thereby;
.2 the Work and materials and equipment to be incorporated therein, whether in storage on or off the site, under care, custody, or control of the Contractor, a Subcontractor, or a Sub-subcontractor; and
.3 other property at the site or adjacent thereto, such as trees, shrubs, lawns, walks, pavements, roadways, structures, and utilities not designated for removal, relocation, or replacement in the course of construction.

§ 10.2.2 The Contractor shall comply with, and give notices required by applicable laws, statutes, ordinances, codes, rules and regulations, and lawful orders of public authorities, bearing on safety of persons or property or their protection from damage, injury, or loss.

§ 10.2.3 The Contractor shall implement, erect, and maintain, as required by existing conditions and performance of the Contract, reasonable safeguards for safety and protection, including posting danger signs and other warnings against hazards; promulgating safety regulations; and notifying the owners and users of adjacent sites and utilities of the safeguards.

§ 10.2.4 When use or storage of explosives or other hazardous materials or equipment, or unusual methods are necessary for execution of the Work, the Contractor shall exercise utmost care and carry on such activities under supervision of properly qualified personnel.

§ 10.2.5 The Contractor shall promptly remedy damage and loss (other than damage or loss insured under property insurance required by the Contract Documents) to property referred to in Sections 10.2.1.2 and 10.2.1.3 caused in whole or in part by the Contractor, a Subcontractor, a Sub-subcontractor, or anyone directly or indirectly employed by any of them, or by anyone for whose acts they may be liable and for which the Contractor is responsible under Sections 10.2.1.2 and 10.2.1.3. The Contractor may make a Claim for the cost to remedy the damage or loss to the extent such damage or loss is attributable to acts or omissions of the Owner or Architect or anyone directly or indirectly employed by either of them, or by anyone for whose acts either of them may be liable, and not attributable to the fault or negligence of the Contractor. The foregoing obligations of the Contractor are in addition to the Contractor's obligations under Section 3.18.

§ 10.2.6 The Contractor shall designate a responsible member of the Contractor's organization at the site whose duty shall be the prevention of accidents. This person shall be the Contractor's superintendent unless otherwise designated by the Contractor in writing to the Owner and Architect.

§ 10.2.7 The Contractor shall not permit any part of the construction or site to be loaded so as to cause damage or create an unsafe condition.

§ 10.2.8 Injury or Damage to Person or Property
If either party suffers injury or damage to person or property because of an act or omission of the other party, or of others for whose acts such party is legally responsible, notice of the injury or damage, whether or not insured, shall be given to the other party within a reasonable time not exceeding 21 days after discovery. The notice shall provide sufficient detail to enable the other party to investigate the matter.

§ 10.3 Hazardous Materials and Substances
§ 10.3.1 The Contractor is responsible for compliance with any requirements included in the Contract Documents regarding hazardous materials or substances. If the Contractor encounters a hazardous material or substance not addressed in the Contract Documents and if reasonable precautions will be inadequate to prevent foreseeable bodily injury or death to persons resulting from a material or substance, including but not limited to asbestos or polychlorinated biphenyl (PCB), encountered on the site by the Contractor, the Contractor shall, upon recognizing the condition, immediately stop Work in the affected area and notify the Owner and Architect of the condition.

§ 10.3.2 Upon receipt of the Contractor's notice, the Owner shall obtain the services of a licensed laboratory to verify the presence or absence of the material or substance reported by the Contractor and, in the event such material or substance is found to be present, to cause it to be rendered harmless. Unless otherwise required by the Contract Documents, the Owner shall furnish in writing to the Contractor and Architect the names and qualifications of persons or entities who are to perform tests verifying the presence or absence of the material or substance or who are to perform the task of removal or safe containment of the material or substance. The Contractor and the Architect will

promptly reply to the Owner in writing stating whether or not either has reasonable objection to the persons or entities proposed by the Owner. If either the Contractor or Architect has an objection to a person or entity proposed by the Owner, the Owner shall propose another to whom the Contractor and the Architect have no reasonable objection. When the material or substance has been rendered harmless, Work in the affected area shall resume upon written agreement of the Owner and Contractor. By Change Order, the Contract Time shall be extended appropriately and the Contract Sum shall be increased by the amount of the Contractor's reasonable additional costs of shutdown, delay, and start-up.

§ 10.3.3 To the fullest extent permitted by law, the Owner shall indemnify and hold harmless the Contractor, Subcontractors, Architect, Architect's consultants, and agents and employees of any of them from and against claims, damages, losses, and expenses, including but not limited to attorneys' fees, arising out of or resulting from performance of the Work in the affected area if in fact the material or substance presents the risk of bodily injury or death as described in Section 10.3.1 and has not been rendered harmless, provided that such claim, damage, loss, or expense is attributable to bodily injury, sickness, disease or death, or to injury to or destruction of tangible property (other than the Work itself), except to the extent that such damage, loss, or expense is due to the fault or negligence of the party seeking indemnity.

§ 10.3.4 The Owner shall not be responsible under this Section 10.3 for hazardous materials or substances the Contractor brings to the site unless such materials or substances are required by the Contract Documents. The Owner shall be responsible for hazardous materials or substances required by the Contract Documents, except to the extent of the Contractor's fault or negligence in the use and handling of such materials or substances.

§ 10.3.5 The Contractor shall reimburse the Owner for the cost and expense the Owner incurs (1) for remediation of hazardous materials or substances the Contractor brings to the site and negligently handles, or (2) where the Contractor fails to perform its obligations under Section 10.3.1, except to the extent that the cost and expense are due to the Owner's fault or negligence.

§ 10.3.6 If, without negligence on the part of the Contractor, the Contractor is held liable by a government agency for the cost of remediation of a hazardous material or substance solely by reason of performing Work as required by the Contract Documents, the Owner shall reimburse the Contractor for all cost and expense thereby incurred.

§ 10.4 Emergencies

In an emergency affecting safety of persons or property, the Contractor shall act, at the Contractor's discretion, to prevent threatened damage, injury, or loss. Additional compensation or extension of time claimed by the Contractor on account of an emergency shall be determined as provided in Article 15 and Article 7.

ARTICLE 11 INSURANCE AND BONDS

§ 11.1 Contractor's Insurance and Bonds

§ 11.1.1 The Contractor shall purchase and maintain insurance of the types and limits of liability, containing the endorsements, and subject to the terms and conditions, as described in the Agreement or elsewhere in the Contract Documents. The Contractor shall purchase and maintain the required insurance from an insurance company or insurance companies lawfully authorized to issue insurance in the jurisdiction where the Project is located. The Owner, Architect, and Architect's consultants shall be named as additional insureds under the Contractor's commercial general liability policy or as otherwise described in the Contract Documents.

§ 11.1.2 The Contractor shall provide surety bonds of the types, for such penal sums, and subject to such terms and conditions as required by the Contract Documents. The Contractor shall purchase and maintain the required bonds from a company or companies lawfully authorized to issue surety bonds in the jurisdiction where the Project is located.

§ 11.1.3 Upon the request of any person or entity appearing to be a potential beneficiary of bonds covering payment of obligations arising under the Contract, the Contractor shall promptly furnish a copy of the bonds or shall authorize a copy to be furnished.

§ 11.1.4 Notice of Cancellation or Expiration of Contractor's Required Insurance. Within three (3) business days of the date the Contractor becomes aware of an impending or actual cancellation or expiration of any insurance required by the Contract Documents, the Contractor shall provide notice to the Owner of such impending or actual cancellation or expiration. Upon receipt of notice from the Contractor, the Owner shall, unless the lapse in coverage arises from an act

or omission of the Owner, have the right to stop the Work until the lapse in coverage has been cured by the procurement of replacement coverage by the Contractor. The furnishing of notice by the Contractor shall not relieve the Contractor of any contractual obligation to provide any required coverage.

§ 11.2 Owner's Insurance

§ 11.2.1 The Owner shall purchase and maintain insurance of the types and limits of liability, containing the endorsements, and subject to the terms and conditions, as described in the Agreement or elsewhere in the Contract Documents. The Owner shall purchase and maintain the required insurance from an insurance company or insurance companies lawfully authorized to issue insurance in the jurisdiction where the Project is located.

§ 11.2.2 Failure to Purchase Required Property Insurance. If the Owner fails to purchase and maintain the required property insurance, with all of the coverages and in the amounts described in the Agreement or elsewhere in the Contract Documents, the Owner shall inform the Contractor in writing prior to commencement of the Work. Upon receipt of notice from the Owner, the Contractor may delay commencement of the Work and may obtain insurance that will protect the interests of the Contractor, Subcontractors, and Sub-Subcontractors in the Work. When the failure to provide coverage has been cured or resolved, the Contract Sum and Contract Time shall be equitably adjusted. In the event the Owner fails to procure coverage, the Owner waives all rights against the Contractor, Subcontractors, and Sub-subcontractors to the extent the loss to the Owner would have been covered by the insurance to have been procured by the Owner. The cost of the insurance shall be charged to the Owner by a Change Order. If the Owner does not provide written notice, and the Contractor is damaged by the failure or neglect of the Owner to purchase or maintain the required insurance, the Owner shall reimburse the Contractor for all reasonable costs and damages attributable thereto.

§ 11.2.3 Notice of Cancellation or Expiration of Owner's Required Property Insurance. Within three (3) business days of the date the Owner becomes aware of an impending or actual cancellation or expiration of any property insurance required by the Contract Documents, the Owner shall provide notice to the Contractor of such impending or actual cancellation or expiration. Unless the lapse in coverage arises from an act or omission of the Contractor: (1) the Contractor, upon receipt of notice from the Owner, shall have the right to stop the Work until the lapse in coverage has been cured by the procurement of replacement coverage by either the Owner or the Contractor; (2) the Contract Time and Contract Sum shall be equitably adjusted; and (3) the Owner waives all rights against the Contractor, Subcontractors, and Sub-subcontractors to the extent any loss to the Owner would have been covered by the insurance had it not expired or been cancelled. If the Contractor purchases replacement coverage, the cost of the insurance shall be charged to the Owner by an appropriate Change Order. The furnishing of notice by the Owner shall not relieve the Owner of any contractual obligation to provide required insurance.

§ 11.3 Waivers of Subrogation

§ 11.3.1 The Owner and Contractor waive all rights against (1) each other and any of their subcontractors, sub-subcontractors, agents, and employees, each of the other; (2) the Architect and Architect's consultants; and (3) Separate Contractors, if any, and any of their subcontractors, sub-subcontractors, agents, and employees, for damages caused by fire, or other causes of loss, to the extent those losses are covered by property insurance required by the Agreement or other property insurance applicable to the Project, except such rights as they have to proceeds of such insurance. The Owner or Contractor, as appropriate, shall require similar written waivers in favor of the individuals and entities identified above from the Architect, Architect's consultants, Separate Contractors, subcontractors, and sub-subcontractors. The policies of insurance purchased and maintained by each person or entity agreeing to waive claims pursuant to this section 11.3.1 shall not prohibit this waiver of subrogation. This waiver of subrogation shall be effective as to a person or entity (1) even though that person or entity would otherwise have a duty of indemnification, contractual or otherwise, (2) even though that person or entity did not pay the insurance premium directly or indirectly, or (3) whether or not the person or entity had an insurable interest in the damaged property.

§ 11.3.2 If during the Project construction period the Owner insures properties, real or personal or both, at or adjacent to the site by property insurance under policies separate from those insuring the Project, or if after final payment property insurance is to be provided on the completed Project through a policy or policies other than those insuring the Project during the construction period, to the extent permissible by such policies, the Owner waives all rights in accordance with the terms of Section 11.3.1 for damages caused by fire or other causes of loss covered by this separate property insurance.

§ 11.4 Loss of Use, Business Interruption, and Delay in Completion Insurance

The Owner, at the Owner's option, may purchase and maintain insurance that will protect the Owner against loss of use of the Owner's property, or the inability to conduct normal operations, due to fire or other causes of loss. The Owner waives all rights of action against the Contractor and Architect for loss of use of the Owner's property, due to fire or other hazards however caused.

§11.5 Adjustment and Settlement of Insured Loss

§ 11.5.1 A loss insured under the property insurance required by the Agreement shall be adjusted by the Owner as fiduciary and made payable to the Owner as fiduciary for the insureds, as their interests may appear, subject to requirements of any applicable mortgagee clause and of Section 11.5.2. The Owner shall pay the Architect and Contractor their just shares of insurance proceeds received by the Owner, and by appropriate agreements the Architect and Contractor shall make payments to their consultants and Subcontractors in similar manner.

§ 11.5.2 Prior to settlement of an insured loss, the Owner shall notify the Contractor of the terms of the proposed settlement as well as the proposed allocation of the insurance proceeds. The Contractor shall have 14 days from receipt of notice to object to the proposed settlement or allocation of the proceeds. If the Contractor does not object, the Owner shall settle the loss and the Contractor shall be bound by the settlement and allocation. Upon receipt, the Owner shall deposit the insurance proceeds in a separate account and make the appropriate distributions. Thereafter, if no other agreement is made or the Owner does not terminate the Contract for convenience, the Owner and Contractor shall execute a Change Order for reconstruction of the damaged or destroyed Work in the amount allocated for that purpose. If the Contractor timely objects to either the terms of the proposed settlement or the allocation of the proceeds, the Owner may proceed to settle the insured loss, and any dispute between the Owner and Contractor arising out of the settlement or allocation of the proceeds shall be resolved pursuant to Article 15. Pending resolution of any dispute, the Owner may issue a Construction Change Directive for the reconstruction of the damaged or destroyed Work.

ARTICLE 12 UNCOVERING AND CORRECTION OF WORK

§ 12.1 Uncovering of Work

§ 12.1.1 If a portion of the Work is covered contrary to the Architect's request or to requirements specifically expressed in the Contract Documents, it must, if requested in writing by the Architect, be uncovered for the Architect's examination and be replaced at the Contractor's expense without change in the Contract Time.

§ 12.1.2 If a portion of the Work has been covered that the Architect has not specifically requested to examine prior to its being covered, the Architect may request to see such Work and it shall be uncovered by the Contractor. If such Work is in accordance with the Contract Documents, the Contractor shall be entitled to an equitable adjustment to the Contract Sum and Contract Time as may be appropriate. If such Work is not in accordance with the Contract Documents, the costs of uncovering the Work, and the cost of correction, shall be at the Contractor's expense.

§ 12.2 Correction of Work

§ 12.2.1 Before Substantial Completion

The Contractor shall promptly correct Work rejected by the Architect or failing to conform to the requirements of the Contract Documents, discovered before Substantial Completion and whether or not fabricated, installed or completed. Costs of correcting such rejected Work, including additional testing and inspections, the cost of uncovering and replacement, and compensation for the Architect's services and expenses made necessary thereby, shall be at the Contractor's expense.

§ 12.2.2 After Substantial Completion

§ 12.2.2.1 In addition to the Contractor's obligations under Section 3.5, if, within one year after the date of Substantial Completion of the Work or designated portion thereof or after the date for commencement of warranties established under Section 9.9.1, or by terms of any applicable special warranty required by the Contract Documents, any of the Work is found to be not in accordance with the requirements of the Contract Documents, the Contractor shall correct it promptly after receipt of notice from the Owner to do so, unless the Owner has previously given the Contractor a written acceptance of such condition. The Owner shall give such notice promptly after discovery of the condition. During the one-year period for correction of Work, if the Owner fails to notify the Contractor and give the Contractor an opportunity to make the correction, the Owner waives the rights to require correction by the Contractor and to make a claim for breach of warranty. If the Contractor fails to correct nonconforming Work within a reasonable time during that period after receipt of notice from the Owner or Architect, the Owner may correct it in accordance with Section 2.5.

§ 12.2.2.2 The one-year period for correction of Work shall be extended with respect to portions of Work first performed after Substantial Completion by the period of time between Substantial Completion and the actual completion of that portion of the Work.

§ 12.2.2.3 The one-year period for correction of Work shall not be extended by corrective Work performed by the Contractor pursuant to this Section 12.2.

§ 12.2.3 The Contractor shall remove from the site portions of the Work that are not in accordance with the requirements of the Contract Documents and are neither corrected by the Contractor nor accepted by the Owner.

§ 12.2.4 The Contractor shall bear the cost of correcting destroyed or damaged construction of the Owner or Separate Contractors, whether completed or partially completed, caused by the Contractor's correction or removal of Work that is not in accordance with the requirements of the Contract Documents.

§ 12.2.5 Nothing contained in this Section 12.2 shall be construed to establish a period of limitation with respect to other obligations the Contractor has under the Contract Documents. Establishment of the one-year period for correction of Work as described in Section 12.2.2 relates only to the specific obligation of the Contractor to correct the Work, and has no relationship to the time within which the obligation to comply with the Contract Documents may be sought to be enforced, nor to the time within which proceedings may be commenced to establish the Contractor's liability with respect to the Contractor's obligations other than specifically to correct the Work.

§ 12.3 Acceptance of Nonconforming Work

If the Owner prefers to accept Work that is not in accordance with the requirements of the Contract Documents, the Owner may do so instead of requiring its removal and correction, in which case the Contract Sum will be reduced as appropriate and equitable. Such adjustment shall be effected whether or not final payment has been made.

ARTICLE 13 MISCELLANEOUS PROVISIONS

§ 13.1 Governing Law

The Contract shall be governed by the law of the place where the Project is located, excluding that jurisdiction's choice of law rules. If the parties have selected arbitration as the method of binding dispute resolution, the Federal Arbitration Act shall govern Section 15.4.

§ 13.2 Successors and Assigns

§ 13.2.1 The Owner and Contractor respectively bind themselves, their partners, successors, assigns, and legal representatives to covenants, agreements, and obligations contained in the Contract Documents. Except as provided in Section 13.2.2, neither party to the Contract shall assign the Contract as a whole without written consent of the other. If either party attempts to make an assignment without such consent, that party shall nevertheless remain legally responsible for all obligations under the Contract.

§ 13.2.2 The Owner may, without consent of the Contractor, assign the Contract to a lender providing construction financing for the Project, if the lender assumes the Owner's rights and obligations under the Contract Documents. The Contractor shall execute all consents reasonably required to facilitate the assignment.

§ 13.3 Rights and Remedies

§ 13.3.1 Duties and obligations imposed by the Contract Documents and rights and remedies available thereunder shall be in addition to and not a limitation of duties, obligations, rights, and remedies otherwise imposed or available by law.

§ 13.3.2 No action or failure to act by the Owner, Architect, or Contractor shall constitute a waiver of a right or duty afforded them under the Contract, nor shall such action or failure to act constitute approval of or acquiescence in a breach thereunder, except as may be specifically agreed upon in writing.

§ 13.4 Tests and Inspections

§ 13.4.1 Tests, inspections, and approvals of portions of the Work shall be made as required by the Contract Documents and by applicable laws, statutes, ordinances, codes, rules, and regulations or lawful orders of public authorities. Unless otherwise provided, the Contractor shall make arrangements for such tests, inspections, and

approvals with an independent testing laboratory or entity acceptable to the Owner, or with the appropriate public authority, and shall bear all related costs of tests, inspections, and approvals. The Contractor shall give the Architect timely notice of when and where tests and inspections are to be made so that the Architect may be present for such procedures. The Owner shall bear costs of tests, inspections, or approvals that do not become requirements until after bids are received or negotiations concluded. The Owner shall directly arrange and pay for tests, inspections, or approvals where building codes or applicable laws or regulations so require.

§ 13.4.2 If the Architect, Owner, or public authorities having jurisdiction determine that portions of the Work require additional testing, inspection, or approval not included under Section 13.4.1, the Architect will, upon written authorization from the Owner, instruct the Contractor to make arrangements for such additional testing, inspection, or approval, by an entity acceptable to the Owner, and the Contractor shall give timely notice to the Architect of when and where tests and inspections are to be made so that the Architect may be present for such procedures. Such costs, except as provided in Section 13.4.3, shall be at the Owner's expense.

§ 13.4.3 If procedures for testing, inspection, or approval under Sections 13.4.1 and 13.4.2 reveal failure of the portions of the Work to comply with requirements established by the Contract Documents, all costs made necessary by such failure, including those of repeated procedures and compensation for the Architect's services and expenses, shall be at the Contractor's expense.

§ 13.4.4 Required certificates of testing, inspection, or approval shall, unless otherwise required by the Contract Documents, be secured by the Contractor and promptly delivered to the Architect.

§ 13.4.5 If the Architect is to observe tests, inspections, or approvals required by the Contract Documents, the Architect will do so promptly and, where practicable, at the normal place of testing.

§ 13.4.6 Tests or inspections conducted pursuant to the Contract Documents shall be made promptly to avoid unreasonable delay in the Work.

§ 13.5 Interest

Payments due and unpaid under the Contract Documents shall bear interest from the date payment is due at the rate the parties agree upon in writing or, in the absence thereof, at the legal rate prevailing from time to time at the place where the Project is located.

ARTICLE 14 TERMINATION OR SUSPENSION OF THE CONTRACT

§ 14.1 Termination by the Contractor

§ 14.1.1 The Contractor may terminate the Contract if the Work is stopped for a period of 30 consecutive days through no act or fault of the Contractor, a Subcontractor, a Sub-subcontractor, their agents or employees, or any other persons or entities performing portions of the Work, for any of the following reasons:

- **.1** Issuance of an order of a court or other public authority having jurisdiction that requires all Work to be stopped;
- **.2** An act of government, such as a declaration of national emergency, that requires all Work to be stopped;
- **.3** Because the Architect has not issued a Certificate for Payment and has not notified the Contractor of the reason for withholding certification as provided in Section 9.4.1, or because the Owner has not made payment on a Certificate for Payment within the time stated in the Contract Documents; or
- **.4** The Owner has failed to furnish to the Contractor reasonable evidence as required by Section 2.2.

§ 14.1.2 The Contractor may terminate the Contract if, through no act or fault of the Contractor, a Subcontractor, a Sub-subcontractor, their agents or employees, or any other persons or entities performing portions of the Work, repeated suspensions, delays, or interruptions of the entire Work by the Owner as described in Section 14.3, constitute in the aggregate more than 100 percent of the total number of days scheduled for completion, or 120 days in any 365-day period, whichever is less.

§ 14.1.3 If one of the reasons described in Section 14.1.1 or 14.1.2 exists, the Contractor may, upon seven days' notice to the Owner and Architect, terminate the Contract and recover from the Owner payment for Work executed, as well as reasonable overhead and profit on Work not executed, and costs incurred by reason of such termination.

§ 14.1.4 If the Work is stopped for a period of 60 consecutive days through no act or fault of the Contractor, a Subcontractor, a Sub-subcontractor, or their agents or employees or any other persons or entities performing portions of the Work because the Owner has repeatedly failed to fulfill the Owner's obligations under the Contract Documents with respect to matters important to the progress of the Work, the Contractor may, upon seven additional days' notice to the Owner and the Architect, terminate the Contract and recover from the Owner as provided in Section 14.1.3.

§ 14.2 Termination by the Owner for Cause

§ 14.2.1 The Owner may terminate the Contract if the Contractor

- **.1** repeatedly refuses or fails to supply enough properly skilled workers or proper materials;
- **.2** fails to make payment to Subcontractors or suppliers in accordance with the respective agreements between the Contractor and the Subcontractors or suppliers;
- **.3** repeatedly disregards applicable laws, statutes, ordinances, codes, rules and regulations, or lawful orders of a public authority; or
- **.4** otherwise is guilty of substantial breach of a provision of the Contract Documents.

§ 14.2.2 When any of the reasons described in Section 14.2.1 exist, and upon certification by the Architect that sufficient cause exists to justify such action, the Owner may, without prejudice to any other rights or remedies of the Owner and after giving the Contractor and the Contractor's surety, if any, seven days' notice, terminate employment of the Contractor and may, subject to any prior rights of the surety:

- **.1** Exclude the Contractor from the site and take possession of all materials, equipment, tools, and construction equipment and machinery thereon owned by the Contractor;
- **.2** Accept assignment of subcontracts pursuant to Section 5.4; and
- **.3** Finish the Work by whatever reasonable method the Owner may deem expedient. Upon written request of the Contractor, the Owner shall furnish to the Contractor a detailed accounting of the costs incurred by the Owner in finishing the Work.

§ 14.2.3 When the Owner terminates the Contract for one of the reasons stated in Section 14.2.1, the Contractor shall not be entitled to receive further payment until the Work is finished.

§ 14.2.4 If the unpaid balance of the Contract Sum exceeds costs of finishing the Work, including compensation for the Architect's services and expenses made necessary thereby, and other damages incurred by the Owner and not expressly waived, such excess shall be paid to the Contractor. If such costs and damages exceed the unpaid balance, the Contractor shall pay the difference to the Owner. The amount to be paid to the Contractor or Owner, as the case may be, shall be certified by the Initial Decision Maker, upon application, and this obligation for payment shall survive termination of the Contract.

§ 14.3 Suspension by the Owner for Convenience

§ 14.3.1 The Owner may, without cause, order the Contractor in writing to suspend, delay or interrupt the Work, in whole or in part for such period of time as the Owner may determine.

§ 14.3.2 The Contract Sum and Contract Time shall be adjusted for increases in the cost and time caused by suspension, delay, or interruption under Section 14.3.1. Adjustment of the Contract Sum shall include profit. No adjustment shall be made to the extent

- **.1** that performance is, was, or would have been, so suspended, delayed, or interrupted, by another cause for which the Contractor is responsible; or
- **.2** that an equitable adjustment is made or denied under another provision of the Contract.

§ 14.4 Termination by the Owner for Convenience

§ 14.4.1 The Owner may, at any time, terminate the Contract for the Owner's convenience and without cause.

§ 14.4.2 Upon receipt of notice from the Owner of such termination for the Owner's convenience, the Contractor shall

- **.1** cease operations as directed by the Owner in the notice;
- **.2** take actions necessary, or that the Owner may direct, for the protection and preservation of the Work; and
- **.3** except for Work directed to be performed prior to the effective date of termination stated in the notice, terminate all existing subcontracts and purchase orders and enter into no further subcontracts and purchase orders.

§ 14.4.3 In case of such termination for the Owner's convenience, the Owner shall pay the Contractor for Work properly executed; costs incurred by reason of the termination, including costs attributable to termination of Subcontracts; and the termination fee, if any, set forth in the Agreement.

ARTICLE 15 CLAIMS AND DISPUTES

§ 15.1 Claims

§ 15.1.1 Definition

A Claim is a demand or assertion by one of the parties seeking, as a matter of right, payment of money, a change in the Contract Time, or other relief with respect to the terms of the Contract. The term "Claim" also includes other disputes and matters in question between the Owner and Contractor arising out of or relating to the Contract. The responsibility to substantiate Claims shall rest with the party making the Claim. This Section 15.1.1 does not require the Owner to file a Claim in order to impose liquidated damages in accordance with the Contract Documents.

§ 15.1.2 Time Limits on Claims

The Owner and Contractor shall commence all Claims and causes of action against the other and arising out of or related to the Contract, whether in contract, tort, breach of warranty or otherwise, in accordance with the requirements of the binding dispute resolution method selected in the Agreement and within the period specified by applicable law, but in any case not more than 10 years after the date of Substantial Completion of the Work. The Owner and Contractor waive all Claims and causes of action not commenced in accordance with this Section 15.1.2.

§ 15.1.3 Notice of Claims

§ 15.1.3.1 Claims by either the Owner or Contractor, where the condition giving rise to the Claim is first discovered prior to expiration of the period for correction of the Work set forth in Section 12.2.2, shall be initiated by notice to the other party and to the Initial Decision Maker with a copy sent to the Architect, if the Architect is not serving as the Initial Decision Maker. Claims by either party under this Section 15.1.3.1 shall be initiated within 21 days after occurrence of the event giving rise to such Claim or within 21 days after the claimant first recognizes the condition giving rise to the Claim, whichever is later.

§ 15.1.3.2 Claims by either the Owner or Contractor, where the condition giving rise to the Claim is first discovered after expiration of the period for correction of the Work set forth in Section 12.2.2, shall be initiated by notice to the other party. In such event, no decision by the Initial Decision Maker is required.

§ 15.1.4 Continuing Contract Performance

§ 15.1.4.1 Pending final resolution of a Claim, except as otherwise agreed in writing or as provided in Section 9.7 and Article 14, the Contractor shall proceed diligently with performance of the Contract and the Owner shall continue to make payments in accordance with the Contract Documents.

§ 15.1.4.2 The Contract Sum and Contract Time shall be adjusted in accordance with the Initial Decision Maker's decision, subject to the right of either party to proceed in accordance with this Article 15. The Architect will issue Certificates for Payment in accordance with the decision of the Initial Decision Maker.

§ 15.1.5 Claims for Additional Cost

If the Contractor wishes to make a Claim for an increase in the Contract Sum, notice as provided in Section 15.1.3 shall be given before proceeding to execute the portion of the Work that is the subject of the Claim. Prior notice is not required for Claims relating to an emergency endangering life or property arising under Section 10.4.

§ 15.1.6 Claims for Additional Time

§ 15.1.6.1 If the Contractor wishes to make a Claim for an increase in the Contract Time, notice as provided in Section 15.1.3 shall be given. The Contractor's Claim shall include an estimate of cost and of probable effect of delay on progress of the Work. In the case of a continuing delay, only one Claim is necessary.

§ 15.1.6.2 If adverse weather conditions are the basis for a Claim for additional time, such Claim shall be documented by data substantiating that weather conditions were abnormal for the period of time, could not have been reasonably anticipated, and had an adverse effect on the scheduled construction.

§ 15.1.7 Waiver of Claims for Consequential Damages

The Contractor and Owner waive Claims against each other for consequential damages arising out of or relating to this Contract. This mutual waiver includes

.1 damages incurred by the Owner for rental expenses, for losses of use, income, profit, financing, business and reputation, and for loss of management or employee productivity or of the services of such persons; and

.2 damages incurred by the Contractor for principal office expenses including the compensation of personnel stationed there, for losses of financing, business and reputation, and for loss of profit, except anticipated profit arising directly from the Work.

This mutual waiver is applicable, without limitation, to all consequential damages due to either party's termination in accordance with Article 14. Nothing contained in this Section 15.1.7 shall be deemed to preclude assessment of liquidated damages, when applicable, in accordance with the requirements of the Contract Documents.

§ 15.2 Initial Decision

§ 15.2.1 Claims, excluding those where the condition giving rise to the Claim is first discovered after expiration of the period for correction of the Work set forth in Section 12.2.2 or arising under Sections 10.3, 10.4, and 11.5, shall be referred to the Initial Decision Maker for initial decision. The Architect will serve as the Initial Decision Maker, unless otherwise indicated in the Agreement. Except for those Claims excluded by this Section 15.2.1, an initial decision shall be required as a condition precedent to mediation of any Claim. If an initial decision has not been rendered within 30 days after the Claim has been referred to the Initial Decision Maker, the party asserting the Claim may demand mediation and binding dispute resolution without a decision having been rendered. Unless the Initial Decision Maker and all affected parties agree, the Initial Decision Maker will not decide disputes between the Contractor and persons or entities other than the Owner.

§ 15.2.2 The Initial Decision Maker will review Claims and within ten days of the receipt of a Claim take one or more of the following actions: (1) request additional supporting data from the claimant or a response with supporting data from the other party, (2) reject the Claim in whole or in part, (3) approve the Claim, (4) suggest a compromise, or (5) advise the parties that the Initial Decision Maker is unable to resolve the Claim if the Initial Decision Maker lacks sufficient information to evaluate the merits of the Claim or if the Initial Decision Maker concludes that, in the Initial Decision Maker's sole discretion, it would be inappropriate for the Initial Decision Maker to resolve the Claim.

§ 15.2.3 In evaluating Claims, the Initial Decision Maker may, but shall not be obligated to, consult with or seek information from either party or from persons with special knowledge or expertise who may assist the Initial Decision Maker in rendering a decision. The Initial Decision Maker may request the Owner to authorize retention of such persons at the Owner's expense.

§ 15.2.4 If the Initial Decision Maker requests a party to provide a response to a Claim or to furnish additional supporting data, such party shall respond, within ten days after receipt of the request, and shall either (1) provide a response on the requested supporting data, (2) advise the Initial Decision Maker when the response or supporting data will be furnished, or (3) advise the Initial Decision Maker that no supporting data will be furnished. Upon receipt of the response or supporting data, if any, the Initial Decision Maker will either reject or approve the Claim in whole or in part.

§ 15.2.5 The Initial Decision Maker will render an initial decision approving or rejecting the Claim, or indicating that the Initial Decision Maker is unable to resolve the Claim. This initial decision shall (1) be in writing; (2) state the reasons therefor; and (3) notify the parties and the Architect, if the Architect is not serving as the Initial Decision Maker, of any change in the Contract Sum or Contract Time or both. The initial decision shall be final and binding on the parties but subject to mediation and, if the parties fail to resolve their dispute through mediation, to binding dispute resolution.

§ 15.2.6 Either party may file for mediation of an initial decision at any time, subject to the terms of Section 15.2.6.1.

§ 15.2.6.1 Either party may, within 30 days from the date of receipt of an initial decision, demand in writing that the other party file for mediation. If such a demand is made and the party receiving the demand fails to file for mediation within 30 days after receipt thereof, then both parties waive their rights to mediate or pursue binding dispute resolution proceedings with respect to the initial decision.

§ 15.2.7 In the event of a Claim against the Contractor, the Owner may, but is not obligated to, notify the surety, if any, of the nature and amount of the Claim. If the Claim relates to a possibility of a Contractor's default, the Owner may, but is not obligated to, notify the surety and request the surety's assistance in resolving the controversy.

§ 15.2.8 If a Claim relates to or is the subject of a mechanic's lien, the party asserting such Claim may proceed in accordance with applicable law to comply with the lien notice or filing deadlines.

§ 15.3 Mediation

§ 15.3.1 Claims, disputes, or other matters in controversy arising out of or related to the Contract, except those waived as provided for in Sections 9.10.4, 9.10.5, and 15.1.7, shall be subject to mediation as a condition precedent to binding dispute resolution.

§ 15.3.2 The parties shall endeavor to resolve their Claims by mediation which, unless the parties mutually agree otherwise, shall be administered by the American Arbitration Association in accordance with its Construction Industry Mediation Procedures in effect on the date of the Agreement. A request for mediation shall be made in writing, delivered to the other party to the Contract, and filed with the person or entity administering the mediation. The request may be made concurrently with the filing of binding dispute resolution proceedings but, in such event, mediation shall proceed in advance of binding dispute resolution proceedings, which shall be stayed pending mediation for a period of 60 days from the date of filing, unless stayed for a longer period by agreement of the parties or court order. If an arbitration is stayed pursuant to this Section 15.3.2, the parties may nonetheless proceed to the selection of the arbitrator(s) and agree upon a schedule for later proceedings.

§ 15.3.3 Either party may, within 30 days from the date that mediation has been concluded without resolution of the dispute or 60 days after mediation has been demanded without resolution of the dispute, demand in writing that the other party file for binding dispute resolution. If such a demand is made and the party receiving the demand fails to file for binding dispute resolution within 60 days after receipt thereof, then both parties waive their rights to binding dispute resolution proceedings with respect to the initial decision.

§ 15.3.4 The parties shall share the mediator's fee and any filing fees equally. The mediation shall be held in the place where the Project is located, unless another location is mutually agreed upon. Agreements reached in mediation shall be enforceable as settlement agreements in any court having jurisdiction thereof.

§ 15.4 Arbitration

§ 15.4.1 If the parties have selected arbitration as the method for binding dispute resolution in the Agreement, any Claim subject to, but not resolved by, mediation shall be subject to arbitration which, unless the parties mutually agree otherwise, shall be administered by the American Arbitration Association in accordance with its Construction Industry Arbitration Rules in effect on the date of the Agreement. The Arbitration shall be conducted in the place where the Project is located, unless another location is mutually agreed upon. A demand for arbitration shall be made in writing, delivered to the other party to the Contract, and filed with the person or entity administering the arbitration. The party filing a notice of demand for arbitration must assert in the demand all Claims then known to that party on which arbitration is permitted to be demanded.

§ 15.4.1.1 A demand for arbitration shall be made no earlier than concurrently with the filing of a request for mediation, but in no event shall it be made after the date when the institution of legal or equitable proceedings based on the Claim would be barred by the applicable statute of limitations. For statute of limitations purposes, receipt of a written demand for arbitration by the person or entity administering the arbitration shall constitute the institution of legal or equitable proceedings based on the Claim.

§ 15.4.2 The award rendered by the arbitrator or arbitrators shall be final, and judgment may be entered upon it in accordance with applicable law in any court having jurisdiction thereof.

§ 15.4.3 The foregoing agreement to arbitrate and other agreements to arbitrate with an additional person or entity duly consented to by parties to the Agreement, shall be specifically enforceable under applicable law in any court having jurisdiction thereof.

§ 15.4.4 Consolidation or Joinder

§ 15.4.4.1 Subject to the rules of the American Arbitration Association or other applicable arbitration rules, either party may consolidate an arbitration conducted under this Agreement with any other arbitration to which it is a party provided that (1) the arbitration agreement governing the other arbitration permits consolidation, (2) the arbitrations to be consolidated substantially involve common questions of law or fact, and (3) the arbitrations employ materially similar procedural rules and methods for selecting arbitrator(s).

§ 15.4.4.2 Subject to the rules of the American Arbitration Association or other applicable arbitration rules, either party may include by joinder persons or entities substantially involved in a common question of law or fact whose presence is required if complete relief is to be accorded in arbitration, provided that the party sought to be joined consents in writing to such joinder. Consent to arbitration involving an additional person or entity shall not constitute consent to arbitration of any claim, dispute or other matter in question not described in the written consent.

§ 15.4.4.3 The Owner and Contractor grant to any person or entity made a party to an arbitration conducted under this Section 15.4, whether by joinder or consolidation, the same rights of joinder and consolidation as those of the Owner and Contractor under this Agreement.

INFORMATION AVAILABLE TO BIDDERS -
NAVAJO NATION BUSINESS PREFERENCE LAW

GENERAL

DOCUMENT INCLUDES

A. Information provided to the Bidder to aid in his/her understanding of the nature and scope of the project.

DESCRIPTION

A. The Bidding requirements of the project require that preference in contracting, subcontracting, and labor be granted in accordance with tribal law. The attached *Navajo Nation Business Preference Law* (the "Law") presents the particular preference provisions enacted by the Navajo Nation, and which are applicable to this project.

B. The copy presented here is complete, accurate, and current to the best of the Owner's knowledge, information, and belief. The Owner makes no representations as to the completeness, current edition, or other characteristic of the Law. Neither the Owner nor the Architect will interpret the Law.

C. The Bidder shall form his/her own conclusions regarding the information presented, and as required elsewhere in the Bidding Documents. Neither the Owner nor the Architect/Engineer accept any responsibility for the conclusions which the Bidder may form.

D. The Bidder shall be responsible for familiarizing himself/herself with the Navajo Nation Business Preference Law. Documents pertaining to this law can be obtained from the Navajo Nation Business Regulatory Office, Window Rock, Arizona.

END OF DOCUMENT

Information Available to Bidders-
Navajo Nation Business Preference Law

NAVAJO NATION BUSINESS OPPORTUNITY SOURCE LIST OF CERTIFIED NAVAJO-OWNED BUSINESSES

GENERAL

DOCUMENT INCLUDES

A. Information provided to the Bidder to aid in his understanding of the nature and scope of the project.

DESCRIPTION

A. The Navajo Nation Business Opportunity Source List is updated on a monthly basis, pursuant to Navajo Nation Council Resolution CAP-37-02 and the Navajo Nation Business Opportunity Act, Title 5, CH. 2 – Section 201 – 215. This Source List provides a listing of Persons, Firms, Enterprises, Organizations, and/or other entities currently certified by the Business Regulatory Department as prioritized under Section 204 (A) (1) and (2) of the revised [Navajo Nation Business Opportunity] Act.

B. The Bidder shall be responsible for familiarizing himself with the Navajo Nation Business Opportunity Source List. Documents pertaining to this law can be obtained from the Navajo Nation Division of Economic Development, Window Rock, Arizona: Business Regulatory Department, P.O. Box 663, Window Rock, Arizona, 86515, telephone: (928) 871-6287, OR via the internet at:

https://zxh054.p3cdn1.secureserver.net/wp-content/uploads/2024/01/Source_List01-24-24.pdf

END OF DOCUMENT

NAVAJO PREFERENCE IN EMPLOYMENT ACT REQUIREMENTS

A. Contractors and subcontractors shall comply with the substantive and procedural requirements of the Navajo Preference in Employment Act ("Act") 15 Navajo Tribal Code §601 et. seq., which includes but is not limited to giving preference in employment to members of the Navajo Nation (the term "employment" includes, but is not limited to the recruitment, hiring, promotion, transfer, training, upgrading, reduction-in-force, retention, and recall of employees). Specific requirements are incorporated into the Contract Documents as indicated in the Summary of Specific Requirements below

B. All information regarding compliance with the Act shall be obtained from:

Mr. Ronald M. Curtis, Director
Office of Navajo Labor Relations
P.O. Box 1943
Window Rock, Navajo Nation, Arizona, 86515
Phone: (928) 871-6800

C. SUMMARY OF SPECIFIC REQUIREMENTS of the NAVAJO PREFERENCE IN EMPLOYMENT ACT ("ACT")

1. All employers shall include and specify a Navajo employment preference policy statement in all job announcements and advertisements and employer policies covered by this Act.

2. All employers shall post in a conspicuous place on its premises for its employees and applicants a Navajo preference policy notice prepared by Office of Navajo Labor Relations (ONLR).

3. Any seniority system of an employer shall be subject to this Act and all other labor laws of the Navajo Nation. Such a seniority system shall not operate to defeat nor prevent the application of the Act.

4. The Navajo Nation when contracting with the state government or one of its entities shall include provisions for Navajo preference in all places of employment as provided herein.

5. All employers shall utilize Navajo Nation employment sources and job services for employee recruitment and referrals; provided, however, that employers do not have the foregoing obligations in the event a Navajo is selected for the employment opportunity who is a current employee of the employer.

6. All employers shall advertise and announce all job vacancies in at least one newspaper and radio station serving the Navajo Nation; provided, however, that employers do not have the foregoing obligations in the event a Navajo is selected for the employment opportunity who is a current employee of the employer.

7. All employers shall use non-discriminatory job qualification and selection criteria in employment.

8. All employers shall not penalize, discipline, discharge nor take any adverse action against any Navajo employee without just cause. A written notification to the employee citing such cause for any of the above actions is required in all cases.

9. All employers shall maintain a safe and clean working environment and provide employment conditions which are free of prejudice, intimidation and harassment.

10. Training shall be an integral part of the specific affirmative action plans or activities for Navajo preference in employment.

11. All employers shall establish written necessary qualifications for each employment position in their work force, a copy of which shall be provided to applicants or candidates at the time they express an interest in such position.

12. All employers doing business or engaged in any project or enterprise within the territorial jurisdiction of the Navajo Nation or pursuant to a contract with the Nation shall submit employment information and reports as required to ONLR. Such reports, in form acceptable to ONLR, shall include all information necessary and appropriate to determine compliance with the provisions of this Act.

END OF NAVAJO PREFERENCE IN EMPLOYMENT ACT REQUIREMENTS

NAVAJO NATION SALES TAX LAW

GENERAL

DOCUMENT INCLUDES

A. Information provided to the Bidder to aid in his understanding of the nature and scope of the project.

DESCRIPTION

A. The Bidder shall be responsible for familiarizing himself with the Navajo Nation Sales Tax Law. Documents pertaining to this law can be obtained from the Navajo Nation Office of the Tax Commission:

Contact Person: Larieta L. Tso, Senior Tax Compliance Officer

Physical Address: Office of the Navajo Tax Commission
HWY 264, 100 Taylor Road
Karigan Professional Building, Suite 115
St. Michaels, Arizona 86511

Postal Address: Office of the Navajo Tax Commission
Post Office Box 1903
Window Rock, Arizona 86515-1903

Telephone/Email: Telephone # (928) 871-6681
FAX # (928) 871-7608
Email: nnontc@navajotax.org

Website Address: https://tax.navajo-nsn.gov/

Questions and/or Comments can be emailed to Raquel Billy, Senior Information Systems Technician: rwbilly@navajotax.org

END OF DOCUMENT

NAVAJO NATION SOLID WASTE CODE

GENERAL

DOCUMENT INCLUDES

A. Information provided to the Bidder to aid in his understanding of the nature and scope of the project.

DESCRIPTION

A. Section 101: Declaration of Purpose: Assertion of Authority
In order to protect the health, safety, welfare, and environment; to manage, protect, and preserve the resources of the Navajo Nation; to maintain the aesthetic appearance of the Navajo Nation and to provide for the exercise of the inherent sovereign powers of self-government by the Navajo Nation, the Navajo Nation hereby asserts it sovereign authority over all actions taken by all persons within the territorial jurisdiction of the Navajo Nation which affect the generation, collection, transportation, storage and disposal of solid waste.

B. Section 102: Interpretation and Application of the Code:
This code shall be liberally construed and applied to ensure its purpose as expressed in Section 101. Upon the effective date of this Code, it shall be unlawful for any person within the territorial jurisdiction of the Navajo Nation as defined in 7 N.T.C. Subsection 254, to impound, divert, withdraw, otherwise make any use of or take any action affecting the use of land for solid waste unless the applicable provisions of this Code and its regulations have been complied with. No rights or privileges shall be recognized to generate, collect, transport, store and/or dispose of solid waste other than those accorded under this Code.

C. The Contractor shall be responsible for familiarizing himself with the Navajo Nation Solid Waste Code. Documents pertaining to this law can be obtained from the Navajo Nation Division of Natural Resources:

Primary Contact:	Executive Director
Mailing Address:	Division of Natural Resources NAVAJO NATION P.O. Box 9000 Window Rock, Arizona 86515-9000
Telephone/Fax:	Telephone: (928) 871-6592 / 6593 Facsimile (928) 871-7040
Website Address:	https://dnr.navajo-nsn.gov/

Questions and/or Comments can be emailed to:
elouisewatchman@frontiernet.net

END OF DOCUMENT

NAVAJO NATION OCCUPATIONAL SAFETY AND HEALTH ACT (OSHA)

GENERAL

DOCUMENT INCLUDES

A. Information provided to the Bidder to aid in his understanding of the nature and scope of the project.

B. The Navajo OSHA Program is an enforcement agency of the Navajo Nation that works to promote and enforce the Navajo Nation Occupational Safety & Health Act of 2000 and the applicable codes to assure every working person, across the Navajo Nation, has safe and healthy working conditions.

DESCRIPTION

A. The Contractor shall be responsible for familiarizing himself with the Navajo Nation Occupational Safety and Health Act. Documents pertaining to this law can be obtained from the administrative offices as noted herein:

Frank Roanhorse, Program Supervisor I
Occupational Safety and Health Administration
NAVAJO NATION
P.O. Box 1447
Window Rock, Arizona 86515-9000
Email: nnosha.request@navajo-nsn.gov
Phone # (928) 871-6822
Fax # (928) 871-6825

Website Address: https://nnosha.navajo-nsn.gov/

END OF DOCUMENT

January 26, 2024 AD24-217

Dyron V. Murphy, President
DYRON MURPHY ARCHITECTS, P.C.
4505 Montbel Place NE
Albuquerque, New Mexico 87107

RE: SHIPROCK FIRST RESPONDERS SUBSTATION

Dear Mr. Murphy:

The Office of Navajo Labor Relations (ONLR) received your request for prevailing wage rates for the above reference project. Please find attached the ONLR wage rates which are applicable to the building construction project for the Shiprock Pinnacle Hotel & Restaurant.

Pursuant to the NPEA Section 607(B)(1) "...In all cases where construction is contemplated for which prevailing wage rates have not been set, the contract letting entity shall submit to ONLR a written request for a project prevailing wage scale. Such request shall be submitted not less than 60 days prior to the scheduled date for bid solicitation and shall include detailed information on the anticipated construction classifications, nature' of the project and completion plans...."

The ONLR respectfully requests that Dyron Murphy Architects, P.C. to review the requirements of the Navajo Preference in Employment Act (NPEA) before any work begins. If a Pre-Construction Conference is scheduled, the ONLR Office at (928) 871-6800 is to be notified and a representative will explain the applicable laws to the general contractor and subcontractors, where necessary.

Should you have any questions, contact our office at (928) 871-6800. Thank You.

Sincerely,

Michael Armijo, CEA
OFFICE OF NAVAJO LABOR RELATIONS

CONCURRENCE:

Ronald M. Curtis, Program Manager I

ATTACHMENTS

OFFICE OF NAVAJO LABOR RELATIONS
PREVAILING WAGE

Wage Decision: ONLR24-0643B Date Issued: January 26, 2024

BUILDING CONSTRUCTION

Building Construction includes the construction, demolition, rehabilitation, and repairs of sheltered enclosures with walk-in access for the purpose of housing persons, machinery, equipment, or supplies.

SHIPROCK FIRST RESPONDERS SUBSTATION
DYRON MURPHY ARCHITECTS, P.C.

Effective January 1, 2024

Trade Classifications:	Hourly Rate:
Asbestos Worker	$ 26.59
Brick Layer/ Block Layer	$ 22.53
Boilermaker	$ 29.99
Carpenter	$ 23.93
Cement Mason/Finisher	$ 22.04
Drywall Hanger	$ 21.56
Drywall Finisher/Taper	$ 21.33
Electrician	$ 25.89
Glazier	$ 21.68
Insulator	$ 23.75
Ironworker	$ 29.55
Laborer	$ 19.36
Lather	$ 23.18
Mechanic	$ 23.75
Painter	$ 21.29
Plasterer	$ 21.27
Plumber/Pipe Fitter	$ 27.34
Roofer	$ 21.58
Sheet Metal Worker	$ 27.40
Soft Floor Layer	$ 21.27
Sprinkler Fitter	$ 29.44
Tile Layer/Setter	$ 21.27

Truck Drivers:	Hourly Rate:
Dump Truck	$ 22.24
Flatbed Truck	$ 21.75
Water Truck	$ 21.85
Equipment Operators:	**Hourly Rate:**
Backhoe	$ 25.05
Broom	$ 24.20
Bulldozer	$ 24.98
Crane	$ 25.89
Front End Loader	$ 23.32
Motor Grader	$ 23.75
Paver	$ 23.58
Roller/Compactor	$ 23.30
Scraper	$ 25.05
Trencher	$ 25.05

The rates listed above are required minimum ONLR Prevailing Wage Rates. Contractors may pay rates above these rates. The ONLR Director will add wage rates for unlisted classifications needed for work only after review and approval. Overtime is one and one - half time the basic rate for hours worked over forty hours in one week. Foremen will receive an additional $7.10 per hour. **Where Federal Funds are involved, the Davis-Bacon rates apply.** Other exceptions may apply in accordance with the *Navajo Preference in Employment Act (NPEA),* Section 7(E). Apprentices must be enrolled in a recognized apprenticeship program as required by Section 7(A)(6) of the NPEA. The appropriate apprenticeship program as outlined by the NPEA Section 7(E)(7) will govern wage rates for such apprentices. These wages apply only to the **SHIPROCK FIRST RESPONDERS SUBSTATION** construction project.

APPROVED:

Ronald M. Curtis, Program Manager I

1/26/24
Date

REVISED 01/01/2024 marmijo

SECTION 00 0110 - TABLE OF CONTENTS

PROCUREMENT AND CONTRACTING REQUIREMENTS

Division 00 -- Procurement and Contracting Requirements

00 0110 - Table of Contents

SPECIFICATIONS

Division 01 -- General Requirements

01 1000 - Summary

01 2000 - Price and Payment Procedures

01 2500 - Substitution Procedures

01 3000 - Administrative Requirements

Division 03 -- Concrete

03 1000 - Concrete Forming and Accessories

03 2000 - Concrete Reinforcement

03 3000 - Cast-in-Place Concrete

03 3511 - Concrete Floor Finishes

Division 04 -- Masonry

04 2200 - Reinforced Unit Masonry

Division 05 -- Metals

05 1000 - Structural Steel

05 2100 - Steel Joist Framing

05 3000 - Metal Decking

05 4000 - Cold-Formed Metal Framing

05 5000 - Metal Fabrications

05 5100 - Metal Stairs

05 5213 - Pipe and Tube Railings

Division 06 -- Wood, Plastics, and Composites

06 1000 - Rough Carpentry

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07 1113 - Bituminous Dampproofing

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07 6200 - Sheet Metal Flashing and Trim

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08 1416 - Flush Wood Doors

08 3100 - Access Doors and Panels

08 3313 - Coiling Counter Doors

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08 3400 - Bullet Resistant Doors and Frames

08 4313 - Aluminum-Framed Storefronts

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09 2400 - Cement Plastering

09 3000 - Tiling

09 6500 - Resilient Flooring

09 6816 - Sheet Carpeting

09 9113 - Exterior Painting

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09 9600 - High-Performance Coatings

09 9723 - Concrete and Masonry Coatings

Division 10 -- Specialties

10 1400 - Signage

10 2113.17 - Solid Phenolic Toilet Compartments

10 2240 - Vertically Folding Operable Walls

10 2600 - Wall and Door Protection

10 2800 - Toilet, Bath, and Laundry Accessories

10 4400 - Fire Protection Specialties

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10 7113.43 - Fixed Sun Screens

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12 3600 - Countertops

12 4813 - Entrance Floor Mats and Frames

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21 0500 - Common Work Results for Fire Suppression

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Division 22 -- Plumbing

22 0500 - Common Work Results for Plumbing

22 0529 - Hangers and Supports for Plumbing Piping

22 0700 - Plumbing Insulation

22 1116 - Domestic Water Piping

22 1119 - Domestic Water Piping Specialities

22 1316 - Sanitary Waste and Vent Piping

22 1319 - Sanitary Waste and Vent Piping Specialities

22 1413 - Facility Storm Drainage Piping

22 3300 - Electric Water Heaters

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Division 23 -- Heating, Ventilating, and Air-Conditioning (HVAC)

23 0000 - Basic Mechanical Requirements

23 0529 - Hangers and Supports for HVAC Piping and Equipment

23 0593 - Testing, Adjusting, and Balancing for HVAC

23 0700 - HVAC Insulation

23 0900 - Instrumentation and Control for HVAC

23 1123 - Facility Natural-Gas Piping

23 3113 - Ductwork

23 3300 - Air Duct Accessories

23 3423 - HVAC Power Ventilators

23 3713 - Diffusers, Registers and Grilles

23 6213 - Packaged Air-Cooled DX Air Conditioning Units

23 8126 - Split System Air Conditioners

Division 26 -- Electrical

26 0500 - Common Work Results for Electrical

26 0519 - Low-Voltage Electrical Power Conductors and Cables Wiring Devices and Plates

26 0526 - Grounding and Bonding for Electrical Systems

26 0529 - Hangers and Supports for Electrical Systems

26 0533 - Raceway and Boxes for Electrical Systems

26 0553 - Identification for Electrical Systems

26 2200 - Low-Voltage Transformers

26 2416 - Panelboards

26 2726 - Wiring Devices

26 2816 - Enclosed Switches and Circuit Breakers

26 4313 - Transient-Voltage Suppression for Low-Voltage Electrical Power Circuits

26 5100 - Interior Lighting

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27 0500 - Common Work Results for Communications

27 1100 - Communications Equipment Room Fittings

27 1300 - Communications Backbone Cabling

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27 5121 - Biophilic Audio-Visual Environmental Systems

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28 3111 - Fire Detection and Alarm System

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31 1000 - Site Clearing

31 2000 - Earth Moving

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32 1216 - Asphalt Paving

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32 1713 - Parking Bumpers

32 1723.13 - Painted Pavement Markings

32 3119 - Decorative Metal Fences and Gates

32 3136 - Security Gates and Barriers

32 8400 - Planting Irrigation

32 9113 - Soils Preparations

32 9300 - Plants

Division 33 -- Utilities

33 0000 - Site Utilities

END OF SECTION

SECTION 01 2000 - PRICE AND PAYMENT PROCEDURES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Procedures for preparation and submittal of applications for progress payments.

B. Documentation of changes in Contract Sum and Contract Time.

C. Change procedures.

D. Correlation of Contractor submittals based on changes.

E. Procedures for preparation and submittal of application for final payment.

1.02 SCHEDULE OF VALUES

A. Use Schedule of Values Form: AIA G703, edition stipulated in the Agreement.

B. Electronic media printout including equivalent information will be considered in lieu of standard form specified; submit draft to Architect for approval.

C. Forms filled out by hand will not be accepted.

D. Format: Utilize the Table of Contents of this Project Manual. Identify each line item with number and title of the specification section. Identify site mobilization and bonds and insurance.

1.03 APPLICATIONS FOR PROGRESS PAYMENTS

A. Payment Period: Submit at intervals stipulated in the Agreement.

B. Electronic media printout including equivalent information will be considered in lieu of standard form specified; submit sample to Architect for approval.

C. Forms filled out by hand will not be accepted.

D. For each item, provide a column for listing each of the following:
   1. Item Number.
   2. Description of work.
   3. Scheduled Values.
   4. Previous Applications.
   5. Work in Place and Stored Materials under this Application.
   6. Authorized Change Orders.
   7. Total Completed and Stored to Date of Application.
   8. Percentage of Completion.
   9. Balance to Finish.
   10. Retainage.

E. Execute certification by signature of authorized officer.

F. Use data from approved Schedule of Values. Provide dollar value in each column for each line item for portion of work performed and for stored products.

G. List each authorized Change Order as a separate line item, listing Change Order number and dollar amount as for an original item of work.

H. Submit one electronic and Four hard-copies of each Application for Payment.

I. Include the following with the application:
   1. Transmittal letter as specified for submittals in Section 01 3000.
   2. Construction progress schedule, revised and current as specified in Section 01 3000.

J. When Architect requires substantiating information, submit data justifying dollar amounts in question. Provide one copy of data with cover letter for each copy of submittal. Show application number and date, and line item by number and description.

1.04 MODIFICATION PROCEDURES

A. For minor changes not involving an adjustment to the Contract Sum or Contract Time, Architect will issue instructions directly to Contractor.

B. For other required changes, Architect will issue a document signed by Owner instructing Contractor to proceed with the change, for subsequent inclusion in a Change Order.
   1. The document will describe the required changes and will designate method of determining any change in Contract Sum or Contract Time.
   2. Promptly execute the change.

C. For changes for which advance pricing is desired, Architect will issue a document that includes a detailed description of a proposed change with supplementary or revised drawings and specifications, a change in Contract Time for executing the change with a stipulation of any overtime work required and the period of time during which the requested price will be considered valid. Contractor shall prepare and submit a fixed price quotation within ____ days.

D. Computation of Change in Contract Amount: As specified in the Agreement and Conditions of the Contract.

E. Substantiation of Costs: Provide full information required for evaluation.
   1. Provide the following data:
      a. Quantities of products, labor, and equipment.
      b. Taxes, insurance, and bonds.
      c. Overhead and profit.
      d. Justification for any change in Contract Time.
      e. Credit for deletions from Contract, similarly documented.

F. Execution of Change Orders: Architect will issue Change Orders for signatures of parties as provided in the Conditions of the Contract.

G. After execution of Change Order, promptly revise Schedule of Values and Application for Payment forms to record each authorized Change Order as a separate line item and adjust the Contract Sum.

1.05 APPLICATION FOR FINAL PAYMENT

A. Prepare Application for Final Payment as specified for progress payments, identifying total adjusted Contract Sum, previous payments, and sum remaining due.

END OF SECTION

SECTION 01 2500 - SUBSTITUTION PROCEDURES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Procedural requirements for proposed substitutions.

1.02 RELATED REQUIREMENTS

A. Section 00 2113 - Instructions to Bidders: Restrictions on timing of substitution requests.

B. Section 01 3000 - Administrative Requirements: Submittal procedures, coordination.

1.03 DEFINITIONS

A. Substitutions: Changes from Contract Documents requirements proposed by Contractor to materials, products, assemblies, and equipment.
   1. Substitutions for Cause: Proposed due to changed Project circumstances beyond Contractor's control.
      a. Unavailability.
      b. Regulatory changes.
   2. Substitutions for Convenience: Proposed due to possibility of offering substantial advantage to the Project.
      a. Substitution requests offering advantages solely to the Contractor will not be considered.

1.04 REFERENCE STANDARDS

A. CSI/CSC Form 1.5C - Substitution Request (During the Bidding/Negotiating Stage); Current Edition.

B. CSI/CSC Form 13.1A - Substitution Request (After the Bidding/Negotiating Phase); Current Edition.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 GENERAL REQUIREMENTS

A. A Substitution Request for products, assemblies, materials, and equipment constitutes a representation that the submitter:
   1. Has investigated proposed product and determined that it meets or exceeds the quality level of the specified product, equipment, assembly, or system.
   2. Agrees to provide the same warranty for the substitution as for the specified product.
   3. Agrees to coordinate installation and make changes to other work that may be required for the work to be complete, with no additional cost to Owner.

4. Waives claims for additional costs or time extension that may subsequently become apparent.

B. Document each request with complete data substantiating compliance of proposed substitution with Contract Documents. Burden of proof is on proposer.

C. Content: Include information necessary for tracking the status of each Substitution Request, and information necessary to provide an actionable response.

D. Limit each request to a single proposed substitution item.

3.02 SUBSTITUTION PROCEDURES DURING PROCUREMENT

A. Submittal Form (before award of contract):
1. Submit substitution requests by completing CSI/CSC Form 1.5C - Substitution Request (During the Bidding/Negotiating Stage). See this form for additional information and instructions. Use only this form; other forms of submission are unacceptable.

B. Owner will consider requests for substitutions only if submitted at least 10 calendar days prior to the date for receipt of bids.

3.03 SUBSTITUTION PROCEDURES DURING CONSTRUCTION

A. Submittal Form (after award of contract):
1. Submit substitution requests by completing CSI/CSC Form 13.1A - Substitution Request. See this form for additional information and instructions. Use only this form; other forms of submission are unacceptable.

3.04 RESOLUTION

A. Architect may request additional information and documentation prior to rendering a decision. Provide this data in an expeditious manner.

B. Architect will notify Contractor in writing of decision to accept or reject request.
1. Architect's decision following review of proposed substitution will be noted on the submitted form.

3.05 ACCEPTANCE

A. Accepted substitutions change the work of the Project. They will be documented and incorporated into work of the project by Change Order, Construction Change Directive, Architectural Supplementary Instructions, or similar instruments provided for in the Conditions of the Contract.

END OF SECTION

SECTION 01 3000 - ADMINISTRATIVE REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. General administrative requirements.

B. Electronic document submittal service.

C. Preconstruction meeting.

D. Site mobilization meeting.

E. Progress meetings.

F. Construction progress schedule.

G. Progress photographs.

H. Coordination drawings.

I. Submittals for review, information, and project closeout.

J. Number of copies of submittals.

K. Requests for Interpretation (RFI) procedures.

L. Submittal procedures.

1.02 RELATED REQUIREMENTS

A. Section 01 6000 - Product Requirements: General product requirements.

1.03 GENERAL ADMINISTRATIVE REQUIREMENTS

A. Comply with requirements of Section 01 7000 - Execution and Closeout Requirements for coordination of execution of administrative tasks with timing of construction activities.

B. Make the following types of submittals to Architect:
   1. Requests for Interpretation (RFI).
   2. Requests for substitution.
   3. Shop drawings, product data, and samples.
   4. Test and inspection reports.
   5. Design data.
   6. Manufacturer's instructions and field reports.
   7. Applications for payment and change order requests.
   8. Progress schedules.
   9. Coordination drawings.
   10. Correction Punch List and Final Correction Punch List for Substantial Completion.
   11. Closeout submittals.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 ELECTRONIC DOCUMENT SUBMITTAL SERVICE

A. All documents transmitted for purposes of administration of the contract are to be in electronic (PDF, MS Word, or MS Excel) format, as appropriate to the document, and transmitted via an Internet-based submittal service that receives, logs and stores documents, provides electronic stamping and signatures, and notifies addressees via email.
   1. Besides submittals for review, information, and closeout, this procedure applies to Requests for Interpretation (RFIs), progress documentation, contract modification documents (e.g. supplementary instructions, change proposals, change orders), applications for payment, field reports and meeting minutes, Contractor's correction punchlist, and any other document any participant wishes to make part of the project record.
   2. Contractor and Architect are required to use this service.
   3. It is Contractor's responsibility to submit documents in allowable format.
   4. Subcontractors, suppliers, and Architect's consultants will be permitted to use the service at no extra charge.
   5. Users of the service need an email address, internet access, and PDF review software that includes ability to mark up and apply electronic stamps (such as Adobe Acrobat, www.adobe.com, or Bluebeam PDF Revu, www.bluebeam.com), unless such software capability is provided by the service provider.
   6. Paper document transmittals will not be reviewed; emailed electronic documents will not be reviewed.
   7. All other specified submittal and document transmission procedures apply, except that electronic document requirements do not apply to samples or color selection charts.

B. Submittal Service: The selected service is:
   1. at contractors discretion.

C. Training: One, one-hour, web-based training session will be arranged for all participants, with representatives of Architect and Contractor participating; further training is the responsibility of the user of the service.

D. Project Closeout: Architect will determine when to terminate the service for the project and is responsible for obtaining archive copies of files for Owner.

3.02 PRECONSTRUCTION MEETING

A. Schedule meeting after Notice of Award.

B. Attendance Required:
   1. Owner.
   2. Architect.
   3. Contractor.
   4. NTUA & any other Utility Providers.

C. Agenda:
   1. Execution of Owner-Contractor Agreement.
   2. Submission of executed bonds and insurance certificates.
   3. Distribution of Contract Documents.
   4. Submission of list of subcontractors, list of products, schedule of values, and progress schedule.
   5. Designation of personnel representing the parties to Contract, Owner and Architect.
   6. Procedures and processing of field decisions, submittals, substitutions, applications for payments, proposal request, Change Orders, and Contract closeout procedures.
   7. Scheduling.

D. Record minutes and distribute copies within two days after meeting to participants, with two copies to Architect, Owner, participants, and those affected by decisions made.

3.03 SITE MOBILIZATION MEETING

A. Attendance Required:
   1. Contractor.
   2. Owner.
   3. Architect.
   4. Contractor's superintendent.
   5. Major subcontractors.

B. Agenda:
   1. Use of premises by Owner and Contractor.
   2. Owner's requirements.
   3. Construction facilities and controls provided by Owner.
   4. Temporary utilities provided by Owner.
   5. Survey and building layout.
   6. Security and housekeeping procedures.
   7. Schedules.
   8. Application for payment procedures.
   9. Procedures for testing.
   10. Procedures for maintaining record documents.
   11. Requirements for start-up of equipment.
   12. Inspection and acceptance of equipment put into service during construction period.

C. Record minutes and distribute copies within two days after meeting to participants, with two copies to Architect, Owner, participants, and those affected by decisions made.

3.04 PROGRESS MEETINGS

A. Schedule and administer meetings throughout progress of the work at maximum bi-monthly intervals.

B. Attendance Required:
   1. Contractor.
   2. Owner.

3. Architect.
4. Contractor's superintendent.
5. Major subcontractors.

C. Agenda:
1. Review minutes of previous meetings.
2. Review of work progress.
3. Field observations, problems, and decisions.
4. Identification of problems that impede, or will impede, planned progress.
5. Review of submittals schedule and status of submittals.
6. Maintenance of progress schedule.
7. Corrective measures to regain projected schedules.
8. Planned progress during succeeding work period.
9. Maintenance of quality and work standards.
10. Effect of proposed changes on progress schedule and coordination.
11. Other business relating to work.

D. Record minutes and distribute copies within two days after meeting to participants, with two copies to Architect, Owner, participants, and those affected by decisions made.

3.05 CONSTRUCTION PROGRESS SCHEDULE

A. If preliminary schedule requires revision after review, submit revised schedule within 10 days.

B. Within 20 days after review of preliminary schedule, submit draft of proposed complete schedule for review.
1. Include written certification that major contractors have reviewed and accepted proposed schedule.

C. Within 10 days after joint review, submit complete schedule.

D. Submit updated schedule with each Application for Payment.

3.06 PROGRESS PHOTOGRAPHS

A. Submit photographs with each application for payment, taken not more than 3 days prior to submission of application for payment.

B. Photography Type: Digital; electronic files.

C. Provide photographs of site and construction throughout progress of work produced by an experienced photographer, acceptable to Architect.

D. In addition to periodic, recurring views, take photographs of each of the following events:

E. Views:
1. Provide non-aerial photographs from four cardinal views at each specified time, until date of Substantial Completion.
2. Consult with Architect for instructions on views required.
3. Provide factual presentation.

4. Provide correct exposure and focus, high resolution and sharpness, maximum depth of field, and minimum distortion.

F. Digital Photographs: 24 bit color, minimum resolution of 1024 by 768, in JPG format; provide files unaltered by photo editing software.
1. Delivery Medium: Via email.
2. File Naming: Include project identification, date and time of view, and view identification.
3. PDF File: Assemble all photos into printable pages in PDF format, with 2 to 3 photos per page, each photo labeled with file name; one PDF file per submittal.
4. Hard Copy: Printed hardcopy (grayscale) of PDF file and point of view sketch.

3.07 COORDINATION DRAWINGS

3.08 REQUESTS FOR INTERPRETATION (RFI)

A. Definition: A request seeking one of the following:
1. An interpretation, amplification, or clarification of some requirement of Contract Documents arising from inability to determine from them the exact material, process, or system to be installed; or when the elements of construction are required to occupy the same space (interference); or when an item of work is described differently at more than one place in the Contract Documents.
2. A resolution to an issue which has arisen due to field conditions and affects design intent.

B. Preparation: Prepare an RFI immediately upon discovery of a need for interpretation of the Contract Documents. Failure to submit a RFI in a timely manner is not a legitimate cause for claiming additional costs or delays in execution of the work.
1. Prepare a separate RFI for each specific item.
   a. Review, coordinate, and comment on requests originating with subcontractors and/or materials suppliers.
   b. Do not forward requests which solely require internal coordination between subcontractors.
2. Prepare using software provided by the Electronic Document Submittal Service.
3. Combine RFI and its attachments into a single electronic file. PDF format is preferred.

C. Reason for the RFI: Prior to initiation of an RFI, carefully study all Contract Documents to confirm that information sufficient for their interpretation is definitely not included.
1. Include in each request Contractor's signature attesting to good faith effort to determine from the Contract Documents information requiring interpretation.
2. Unacceptable Uses for RFIs: Do not use RFIs to request the following::
   a. Approval of submittals (use procedures specified elsewhere in this section).
   b. Approval of substitutions (see Section - 01 6000 - Product Requirements)
   c. Changes that entail change in Contract Time and Contract Sum (comply with provisions of the Conditions of the Contract).
   d. Different methods of performing work than those indicated in the Contract Drawings and Specifications (comply with provisions of the Conditions of the Contract).

3. Improper RFIs: Requests not prepared in compliance with requirements of this section, and/or missing key information required to render an actionable response. They will be returned without a response, with an explanatory notation.
4. Frivolous RFIs: Requests regarding information that is clearly indicated on, or reasonably inferable from, the Contract Documents, with no additional input required to clarify the question. They will be returned without a response, with an explanatory notation.
    a. The Owner reserves the right to assess the Contractor for the costs (on time-and-materials basis) incurred by the Architect, and any of its consultants, due to processing of such RFIs.

D. Content: Include identifiers necessary for tracking the status of each RFI, and information necessary to provide an actionable response.
1. Official Project name and number, and any additional required identifiers established in Contract Documents.
2. Owner's, Architect's, and Contractor's names.
3. Discrete and consecutive RFI number, and descriptive subject/title.
4. Issue date, and requested reply date.
5. Reference to particular Contract Document(s) requiring additional information/interpretation. Identify pertinent drawing and detail number and/or specification section number, title, and paragraph(s).
6. Annotations: Field dimensions and/or description of conditions which have engendered the request.
7. Contractor's suggested resolution: A written and/or a graphic solution, to scale, is required in cases where clarification of coordination issues is involved, for example; routing, clearances, and/or specific locations of work shown diagrammatically in Contract Documents. If applicable, state the likely impact of the suggested resolution on Contract Time or the Contract Sum.

E. Attachments: Include sketches, coordination drawings, descriptions, photos, submittals, and other information necessary to substantiate the reason for the request.

F. RFI Log: Prepare and maintain a tabular log of RFIs for the duration of the project.
1. Indicate current status of every RFI. Update log promptly and on a regular basis.
2. Note dates of when each request is made, and when a response is received.
3. Highlight items requiring priority or expedited response.
4. Highlight items for which a timely response has not been received to date.

G. Review Time: Architect will respond and return RFIs to Contractor within seven calendar days of receipt. For the purpose of establishing the start of the mandated response period, RFIs received after 12:00 noon will be considered as having been received on the following regular working day.
1. Response period may be shortened or lengthened for specific items, subject to mutual agreement, and recorded in a timely manner in progress meeting minutes.

H. Responses: Content of answered RFIs will not constitute in any manner a directive or authorization to perform extra work or delay the project. If in Contractor's belief it is likely to lead to a change to Contract Sum or Contract Time, promptly issue a notice to this effect, and follow up with an appropriate Change Order request to Owner.

1. Response may include a request for additional information, in which case the original RFI will be deemed as having been answered, and an amended one is to be issued forthwith. Identify the amended RFI with an R suffix to the original number.
2. Do not extend applicability of a response to specific item to encompass other similar conditions, unless specifically so noted in the response.
3. Upon receipt of a response, promptly review and distribute it to all affected parties, and update the RFI Log.
4. Notify Architect within seven calendar days if an additional or corrected response is required by submitting an amended version of the original RFI, identified as specified above.

3.09 SUBMITTAL SCHEDULE

A. Submit to Architect for review a schedule for submittals in tabular format.
   1. Coordinate with Contractor's construction schedule and schedule of values.
   2. Format schedule to allow tracking of status of submittals throughout duration of construction.
   3. Arrange information to include scheduled date for initial submittal, specification number and title, submittal category (for review or for information), description of item of work covered, and role and name of subcontractor.
   4. Account for time required for preparation, review, manufacturing, fabrication and delivery when establishing submittal delivery and review deadline dates.
      a. For assemblies, equipment, systems comprised of multiple components and/or requiring detailed coordination with other work, allow for additional time to make corrections or revisions to initial submittals, and time for their review.

3.10 SUBMITTALS FOR REVIEW

A. When the following are specified in individual sections, submit them for review:
   1. Product data.
   2. Shop drawings.
   3. Samples for selection.
   4. Samples for verification.

B. Submit to Architect for review for the limited purpose of checking for compliance with information given and the design concept expressed in the contract documents.

C. Samples will be reviewed for aesthetic, color, or finish selection.

D. After review, provide copies and distribute in accordance with SUBMITTAL PROCEDURES article below and for record documents purposes described in Section 01 7800 - Closeout Submittals.

3.11 SUBMITTALS FOR INFORMATION

A. When the following are specified in individual sections, submit them for information:
   1. Design data.
   2. Certificates.
   3. Test reports.

4. Inspection reports.
5. Manufacturer's instructions.
6. Manufacturer's field reports.
7. Other types indicated.

B. Submit for Architect's knowledge as contract administrator or for Owner.

3.12 SUBMITTALS FOR PROJECT CLOSEOUT

A. Submit Correction Punch List for Substantial Completion.

B. Submit Final Correction Punch List for Substantial Completion.

C. When the following are specified in individual sections, submit them at project closeout in compliance with requirements of Section 01 7800 - Closeout Submittals:
1. Project record documents.
2. Operation and maintenance data.
3. Warranties.
4. Bonds.
5. Other types as indicated.

D. Submit for Owner's benefit during and after project completion.

3.13 NUMBER OF COPIES OF SUBMITTALS

A. Electronic Documents: Submit one electronic copy in PDF format; an electronically-marked up file will be returned. Create PDFs at native size and right-side up; illegible files will be rejected.

B. Samples: Submit the number specified in individual specification sections; one of which will be retained by Architect.
1. After review, produce duplicates.
2. Retained samples will not be returned to Contractor unless specifically so stated.

3.14 SUBMITTAL PROCEDURES

A. General Requirements:
1. Use a single transmittal for related items.
2. Sequentially identify each item. For revised submittals use original number and a sequential numerical suffix.
3. Identify: Project; Contractor; subcontractor or supplier; pertinent drawing and detail number; and specification section number and article/paragraph, as appropriate on each copy.
4. Apply Contractor's stamp, signed or initialed certifying that review, approval, verification of products required, field dimensions, adjacent construction work, and coordination of information is in accordance with the requirements of the work and Contract Documents.
    a. Submittals from sources other than the Contractor, or without Contractor's stamp will not be acknowledged, reviewed, or returned.

5. Deliver each submittal on date noted in submittal schedule, unless an earlier date has been agreed to by all affected parties, and is of the benefit to the project.
    a. Send submittals in electronic format via email to Architect.
6. Schedule submittals to expedite the Project, and coordinate submission of related items.
    a. For each submittal for review, allow 15 working days excluding delivery time to and from the Contractor.
    b. For sequential reviews involving Architect's consultants, Owner, or another affected party, allow an additional 7 days.
7. Identify variations from Contract Documents and product or system limitations that may be detrimental to successful performance of the completed work.
8. Provide space for Contractor and Architect review stamps.
9. When revised for resubmission, identify all changes made since previous submission.
10. Distribute reviewed submittals. Instruct parties to promptly report inability to comply with requirements.
11. Incomplete submittals will not be reviewed, unless they are partial submittals for distinct portion(s) of the work, and have received prior approval for their use.

B. Product Data Procedures:
1. Submit only information required by individual specification sections.
2. Collect required information into a single submittal.
3. Do not submit (Material) Safety Data Sheets for materials or products.

C. Shop Drawing Procedures:
1. Prepare accurate, drawn-to-scale, original shop drawing documentation by interpreting the Contract Documents and coordinating related work.
2. Generic, non-project-specific information submitted as shop drawings do not meet the requirements for shop drawings.

D. Samples Procedures:
1. Transmit related items together as single package.
2. Identify each item to allow review for applicability in relation to shop drawings showing installation locations.

3.15 SUBMITTAL REVIEW

A. Submittals for Review: Architect will review each submittal, and approve, or take other appropriate action.

B. Submittals for Information: Architect will acknowledge receipt and review. See below for actions to be taken.

C. Architect's actions will be reflected by marking each returned submittal using virtual stamp on electronic submittals.

D. Architect's and consultants' actions on items submitted for review:
1. Authorizing purchasing, fabrication, delivery, and installation:
    a. "Approved", or language with same legal meaning.
    b. "Approved as Noted, Resubmission not required", or language with same legal meaning.

1) At Contractor's option, submit corrected item, with review notations acknowledged and incorporated.

c. "Approved as Noted, Resubmit for Record", or language with same legal meaning.

2. Not Authorizing fabrication, delivery, and installation:

E. Architect's and consultants' actions on items submitted for information:

1. Items for which no action was taken:

a. "Received" - to notify the Contractor that the submittal has been received for record only.

2. Items for which action was taken:

a. "Reviewed" - no further action is required from Contractor.

END OF SECTION

SECTION 03 1000
CONCRETE FORMING AND ACCESSORIES

PART 1 GENERAL

1.01 WORK INCLUDED

A. This section includes formwork for cast-in-place concrete, including water stops, and installation of embedded items.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Concrete Reinforcement - Section 03 20 00

B. Cast-In-Place Concrete - Section 03 30 00

C. Under-Slab Vapor Retarder – Section 07 26 00

1.03 QUALITY ASSURANCE

A. Comply with the American Concrete Institute Standard, ACI 347-04, Recommended Practice for Concrete Formwork.

1.04 REFERENCE STANDARDS

A. American Society for Testing and Materials (ASTM)

1.	ASTM D 226-09	Specification for Asphalt - Saturated Organic Felt used in Roofing and Waterproofing"
2.	ASTM D 1751-04	Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)

PART 2 PRODUCTS

2.01 MATERIALS

A. Forms for Exposed Finish Concrete: Plywood complying with Voluntary Product Standard PS 1-07 "B-B (Concrete Form) Plywood", Class I, Exterior Grade or better or metal, metal-framed plywood or other acceptable panel-type materials. Plywood shall be mill-oiled and edge-sealed, with each piece bearing legible inspection trademark. Furnish in largest practicable sizes to minimize number of joints. Provide form material with sufficient thickness to withstand pressure of newly placed concrete without bow or deflection.

B. Forms for Unexposed Finish Concrete: Use plywood, lumber, metal or other acceptable material. Provide lumber dressed on at least 2 edges and one side for tight fit.

C. Form Coatings: Commercial formulation that will not bond with, stain, or adversely affect concrete surfaces, and will not impair subsequent treatments of concrete surfaces.

D. Chamfer Strips: ¾ inch by ¾ inch wood, PVC, or rubber.

E. Preformed Construction Joint: 24-gage steel, galvanized, shaped to form a continuous tongue and groove key.

F. Preformed Control Joint: Rigid plastic or metal strip with removable top section.

G. Expansion Joint Material: Asphalt saturated fiberboard, ½ inch thick, meeting the requirements of ASTM D 1751.

H. Felt: Asphalt-saturated organic felt, weighing 30 pounds per 100 square feet, meeting the requirements of ASTM D 226.

I. Water stops: PVC, meeting the requirements of CRD-C572. Provide 6 inches wide dumbbell shape water stop with 3/16-inch minimum web thickness and 3/8 inch minimum end bulb diameter.

J. Recycled Content: Minimum 5 percent post-consumer content, or minimum 20 percent pre-consumer recycled content at contractor’s option.

PART 3 EXECUTION

3.01 COORDINATION

A. Coordinate the installation of joint materials and moisture barriers with placement of forms and reinforcing steel. Set screeds accurately. Embedded items shall be accurately aligned and adequately supported. Verify installation of mechanical, plumbing, and electrical items to be embedded in concrete. Correct any unsatisfactory condition before proceeding further.

3.02 PREPARATION

A. Form Coating: Coat contact surfaces of forms with a form coating compound before reinforcement is placed. Thin form-coating compounds with thinning agent and apply as specified in manufacturer's instructions. Do not allow excess form-coating material to accumulate in forms or to come into contact with concrete surfaces against which fresh concrete will be placed.

3.03 INSTALLATION

A. Formwork: Formwork shall support vertical and lateral loads that are applied until such loads can be supported by concrete structure. Formwork shall be readily removable without impact, shock or damage to cast-in-place concrete surfaces and adjacent materials. Construct forms to sizes, shapes, lines and dimensions shown. Perform surveys to obtain accurate alignment. Provide for recesses, chamfers, blocking, anchorages, inserts, and other features required in work. Select materials to obtain required finishes. Butt joints solidly and provide backup at joints to prevent leakage of cement paste.

B. Chamfer Strips: Provide at exposed corners and edges.

C. Form Ties: Use factory fabricated, adjustable-length, removable or snap-off metal form ties, designed to prevent form deflection and to prevent spalling concrete surfaces upon removal.

D. Cleaning and Tightening: Thoroughly clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, or other debris before concrete is placed. Retighten forms and bracing after concrete placement as required to eliminate mortar leaks and maintain proper alignment.

3.04 INSTALLATION OF EMBEDDED ITEMS

A. General: Set anchorage devices and other embedded items accurately. Use setting drawings, diagrams, templates and printed instructions provided by supplier. Secure embedded items such that they are not displaced during placement of concrete.

B. Water stops: Install according to manufacturers printed instructions. Splice water stop sections using square cut butt joints and fuse sections together with indirect heat from preheated splicing iron. Use of direct flame is prohibited.

1. Place water stops in all concrete construction joints in basement walls around the building perimeter that are exposed to soil, weather, or moisture, and in any other construction joints that have the potential to allow water infiltration into the building.

3.05 JOINTS

A. Construction Joints in Elevated Slabs and Beams: Construction joints in Elevated Slabs, Beams, Grade Beams, and other flexural members shall only be made as shown in the contract drawings or as approved by the Engineer of Record. Joints shall be constructed in accordance with ACI 318 Section 6.4 with provisions made for the transfer of shear and other forces. Reinforcement shall be continuous through these joints unless noted otherwise.

B. Construction Joints in Walls, Foundations, and Slabs on Grade: Provide keyways at least 1 ½ inches deep in vertical construction joints in walls and construction joints in slabs on grade and foundations. Discontinue every other horizontal bar through slab on grade construction joints unless noted otherwise.

C. Preformed Construction Joint for Slabs on Grade: Secure with galvanized steel stakes, 1/8 inch thick by 1-1/8 inches wide with ½ inch deep rib and tapered point. Splice adjoining joints with 24 gage steel, galvanized splice plates.

D. Isolation Joints in Slabs on Grade: Construct isolation joints in interior slabs using 30 lb. felt. Provide isolation joints at points of contact between slabs on grade and vertical surfaces, such as column pedestals, foundation walls, grade beams and elsewhere as indicated. Construct isolation joints on exterior slabs abutting vertical surfaces with ½ inch thick expansion joint material.

E. Control Joints in Slabs-on-Grade:

1. Preformed Strip: Insert premolded rigid plastic, or metal strip into fresh concrete. Cut groove for strip using 10-foot long straight edge cutting tool. Depths of strip shall be one fourth of slab thickness. Press strip into groove such that top of strip is level with the concrete surface. Pull off removable top section, if any, prior to troweling.

2. Saw Cut: Contractor may saw cut control joints instead of using preformed strips. Saw cut joints shall be 1/8 inch wide. Saw cut depth should equal 1/4 of slab depth. Cut joints after concrete has hardened sufficiently to prevent raveling; usually 4 to 12 hours after slab has been cast and finished. Use diamond or silicone-carbide blades.

F. Control Joints in Walls: Create weakened planes in cantilevered retaining walls at 25 feet on center. Use preformed strips, placed vertically, full height in each face of wall. Depth of strips shall be one inch.

3.06 REMOVAL OF FORMWORK

A. General: Prevent excessive deflection, distortion, and damage to concrete when forms are stripped. Provide crush plates or wrecking plates where stripping may damage cast concrete surfaces.

B. Formwork and supports at sides of concrete shall remain in place for 24 hours after concrete placement. This period represents cumulative number of hours, not necessarily consecutive, during which the temperature of the air surrounding the concrete is above 50 degrees F. Formwork and shoring which support the weight of concrete shall not be removed until concrete has attained its specified compressive strength.

C. Ensure safety of the structure. Do not superimpose any load on concrete until forms are removed and concrete is cured.

3.07 RE-USE OF FORMS

A. General: Clean and repair surfaces of forms to be re-used in work. Split, frayed, delaminated, or otherwise damaged form facing material will not be acceptable for exposed surfaces. Apply new form coating compound as specified for new formwork.

When forms are intended for successive concrete placement, thoroughly clean surfaces and remove fins and latence. Align and secure joints to avoid offsets. Do not use "patched" forms for exposed concrete surfaces.

END OF SECTION

SECTION 03 2000
CONCRETE REINFORCEMENT

PART 1 GENERAL

1.01 WORK INCLUDED

A. This section includes fabrication and installation of deformed bar and welded wire fabric reinforcing steel.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Concrete Forming and Accessories - Section 03 10 00.

B. Cast In Place Concrete - Section 03 30 00.

1.03 QUALITY ASSURANCE

A. Reference Standards:

1. American Concrete Institute (ACI)

a.	ACI 301-05	Specifications for Structural Concrete for Buildings
b.	ACI 315-99	Details and Detailing of Concrete Reinforcement
c.	ACI 318-05	Building Code Requirements for Structural Concrete

2. American Society for Testing and Materials (ASTM)

a.	ASTM A 82/ A82M-07	Standard Specification for Steel Wire, plain, for Concrete Reinforcement
b.	ASTM A 185/ A185M-07	Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete
c.	ASTM A 615/ A 615M-09b	Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement

3. Concrete Reinforcing Steel Institute (CRSI). Design Handbook - 2002 Edition

1.04 SUBMITTALS

A. Shop Drawings: Submit shop drawings for reinforcing steel. Comply with ACI 315 requirements showing layout, bar schedules, stirrup spacing, diagrams of bent bars, and arrangement of reinforcing steel. Shop Drawings shall not be made by reproduction of the Contract Drawings.

PART 2 PRODUCTS

2.01 MATERIALS

A. Reinforcing Bars: ASTM A 615, Grade 60. Stirrups and ties may be Grade 40.

B. Welded Wire Fabric: ASTM A 185, flat sheets.

C. Steel Wire: ASTM A 82, 16 gage.

D. Supports for Reinforcing Steel: Wire bar type and precast concrete block type meeting the requirements of CRSI Manual of Standard Practice.

2.02 FABRICATION

A. Fabricate reinforcing steel in accordance with fabricating tolerances in ACI 315.

B. Do not fabricate reinforcing steel until shop drawings are approved.

PART 3 EXECUTION

3.01 PLACING BAR SUPPORTS

A. General: Provide bar supports meeting the requirements of CRSI Specification for Placing Bar Supports.

B. Slabs-on-grade: Use supports with sand plates or precast concrete blocks or horizontal runners where base material will not support chair legs.

3.02 PLACING REINFORCING STEEL

A. General: Comply with CRSI Code of Standard Practice for "Placing Reinforcing Bars".

B. Clean reinforcing steel of loose rust and mill scale, earth, ice, and other materials, which reduce or destroy bond with concrete.

C. Accurately position, support and secure reinforcing steel against displacement by formwork, construction, or concrete placement operations. Place reinforcing steel to obtain minimum coverages. Arrange, space and securely tie bars and bar supports to hold reinforcing steel in position during concrete placement operations. Set wire ties so ends are directed into concrete, not toward exposed concrete surfaces.

Concrete Cover:	
Concrete cast against and permanently exposed to earth	3 inches
Concrete exposed to earth or weather:	
Bars larger than No. 5	2 inches
Bars No. 5 or smaller.	1 ½ inches

D. Rebar Splices: Locate at points of minimum stress or as shown on contract drawings. Unless noted otherwise, provide lap splices 30 bar diameters (18 inches minimum) in length.

E. Welded Wire Fabric Splices: Lap one complete wire spacing.

F. Corner Reinforcing: Provide corner bars of same size and spacing as horizontal reinforcing steel. Lap with horizontal reinforcing 30 bar diameters or 18 inches minimum length.

G. Reinforcing at Construction/Control Joints: Continue reinforcing steel through construction joints unless noted otherwise. Discontinue reinforcing steel 2 inches from preformed construction joints in slabs-on-grade. Cut alternate longitudinal bars at weakened plane control joints in walls.

END OF SECTION

SECTION 03 3000

CAST IN PLACE CONCRETE

PART 1 GENERAL

1.01 WORK INCLUDED

A. This section covers cast-in-place concrete including finishing, surface repair and curing.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Concrete Forming and Accessories - Section 03 10 00

B. Concrete Reinforcement - Section 03 20 00

C. Under Slab Vapor Retarder – Section 07 26 00

1.03 QUALITY ASSURANCE

A. Reference Standards: Meet the requirements of the following codes, specifications and standards.

1. American Concrete Institute (ACI) Publications;

a.	ACI 301-05	Specifications for Structural Concrete for Buildings
b.	ACI 306.1-90	Standard Specification for Cold Weather Concreting
c.	ACI 318-05	Building Code Requirements for Structural Concrete.

2. ASTM International (ASTM);

a.	ASTM C 31/ C31M-10	Standard Practice for Making and Curing Concrete Test Specimens in the Field
b.	ASTM C 33/ C33M-11a	Standard Specification for Concrete Aggregates
c.	ASTM C 39/ C39M-11a	Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
d.	ASTM C 94/ C 94M-11b	Standard Specification for Ready-Mixed Concrete
e.	ASTM C 131-06	Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
f.	ASTM C 136-06	Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
g.	ASTM C 143 C 143M-10a	Standard Test Method for Slump of Hydraulic Cement Concrete
h.	ASTM C 150/ C150M-11	Standard Specification for Portland Cement
i.	ASTM C 171-07	Standard Specification for Sheet Materials for Curing Concrete
j.	ASTM C 172/ C172M-10	Standard Practice for Sampling Freshly Mixed Concrete
k.	ASTM C 173/ C 173M-10b	Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method
l.	ASTM C 231/ C231M-10	Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
m.	ASTM C 260/ C260M-10a	Standard Specification for Air Entraining Admixtures for Concrete

n. ASTM C 309-11 Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete

o. ASTM C 330/ 330M-09 Standard Specification for Lightweight Aggregates for Structural Concrete

p. ASTM C 494/ C 494M-11 Standard Specification for Chemical Admixtures for Concrete

q. ASTM C 567-05a Standard Test Method for Determining Density of Structural Lightweight Concrete

r. ASTM C 618-08a Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete

s. ASTM D 4318-10 Standard Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils

B. Environmental Requirements: Manufacturer and Contractor shall conform to Federal, State, and Local V.O.C. (Volatile Organic Compound) Regulations in area where Project is located. Notify A/E in writing if variations to Specifications herein are required.

1. V.O.C. content shall be a maximum 250 (55) gm/liter, unless more stringent codes or laws apply.

1.04 SUBMITTALS

A. Product Data: Submit manufacturer's product data with application and installation instructions for proprietary materials and admixtures.

B. Concrete Mix Design:

1. Submit mix design in accordance with ACI-301, Section 4.

2. Submit with mix design results of laboratory tests performed within previous 12 months indicating aggregates from the proposed source comply with the requirements of ASTM C 33 or C 330 as applicable.

3. Submit the proposed area of use for each mix design submitted (footings, stemwalls, slabs, walls, columns, etc.).

C. Granular Base Course: Submit gradation, plasticity index, and wear information.

D. Test Reports: Submit copies of test reports for concrete compressive strength, air content, temperature and slump. Submit copies of granular base course test reports.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.

Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."

B. Environmental Requirements: Manufacturer and Contractor shall conform to Federal, State, and Local V.O.C. (Volatile Organic Compound) Regulations in area where Project is located. Notify A/E in writing if variations to Specifications herein are required.

1. V.O.C. content shall be a maximum 250 (55) gm/liter, unless more stringent codes or laws apply.

PART 2 PRODUCTS

2.01 MATERIALS

A. Portland Cement: ASTM C 150, Type I or II, low alkali. Use one brand of cement throughout project.

B. Normal Weight Aggregates: ASTM C 33. Provide aggregates from a single source for exposed concrete.

C. Water: Potable.

D. Air-Entraining Admixture: ASTM C 260.

E. Water Reducing Admixture: ASTM C 494.

F. Fly-Ash: ASTM C 618

G. Moisture-Retaining Cover: Provide waterproof paper, polyethylene film, or polyethylene-coated burlap meeting the requirements of ASTM C 171.

H. Liquid Membrane-Forming Curing Compound: Liquid type membrane-forming curing compound meeting the requirements of ASTM C 309; Type 1-D with fugitive dye for interior concrete and foundations; Type 2, white pigmented, for exposed exterior concrete except exposed exterior Architectural concrete, use Type 1-D.

Curing compound shall NOT be used on interior slabs, except exposed integrally colored concrete slabs. Curing compound to be used on integrally colored concrete slabs shall be approved by the manufacturer of the color.

I. Vapor Retarder shall comply with Section 07 26 00 of these Specifications.

J. Granular base shall meet the following grading requirements when tested in accordance with ASTM C 136.

Granular base shall meet the gradation and material properties requirements as listed in the General Structural Notes.

The plasticity Index shall be no greater than 3 when tested in accordance with ASTM D 4318. The coarse aggregate shall have a percent wear of 50 or less when tested in accordance with ASTM C 131.

2.02 PROPORTIONING AND DESIGN OF MIXES

A. Prepare design mixes for each type and strength of concrete by either laboratory trial mixture or field experience methods as specified in ACI 301, Section 4. If trial mixture method is used, employ an independent testing facility, acceptable to Architect, for preparing and reporting proposed mix designs.

B. Submit written reports to Architect, or Engineer, of each proposed mix for each class of concrete at least 15 days prior to start of work. Do not begin concrete production until mixes have been approved.

C. Refer to the General Structural Notes for concrete strengths.

D. Slabs-on-ground or on vapor retarder shall have a water/total cementitious ratio not to exceed 0.45.

E. Admixtures

1. Use water reducing admixture conforming to ASTM C 494, Type A, in all concrete unless approved otherwise by the Structural Engineer.
2. All other admixtures shall have the written approval of the Architect or Structural Engineer.
3. Calcium chloride is not permitted.
4. All admixtures, except high range water reducers, shall be added to the concrete at the batch plant.

PART 3 EXECUTION

3.01 COORDINATION

A. Coordinate the installation of joint materials and moisture barriers with placement of forms and reinforcing steel. Set screeds accurately. Embedded items shall be accurately aligned and adequately supported. Verify installation of mechanical, plumbing, and electrical items to be embedded in concrete. Correct any unsatisfactory condition before proceeding further.

3.02 PREPARATION

A. Before placing concrete, clean and roughen surface of previously placed concrete. Clean reinforcing steel. Remove debris, providing clean-outs at bottom of forms when necessary. Moisten surfaces to receive concrete unless otherwise prepared. Remove excess water before placing concrete.

3.03 CONCRETE PLACEMENT

A. General: Comply with ACI 301.

B. Place concrete continuously in layers not deeper than 24 inches. Concrete shall not be placed against concrete which has hardened sufficiently to cause the formation of seams or planes of weakness. If a section cannot be placed continuously, provide construction joints. Deposit concrete as nearly as practicable to its final location to avoid segregation. Do not use vibrators to transport concrete.

C. Maintain reinforcing in proper position during concrete placement operations.

D. Consolidate concrete, immediately after placing, by mechanical vibrating equipment supplemented by hand-spading, rodding or tamping. Use equipment and procedures for consolidation of concrete in accordance with ACI recommended practices.

E. Bring slab surfaces to correct level with straightedge and strikeoff. Use bull floats or darbies to smooth surface. Do not disturb slab surfaces prior to beginning finishing operations.

F. Cold Weather Concreting: Protect concrete work from physical damage or reduced strength caused by frost, freezing or low temperatures. Comply with ACI 306.1.

G. Hot Weather Concreting: When hot weather conditions exist that would impair quality and strength of concrete, reduce delivery time of ready mix concrete, lower the temperature of materials, or add retarder to ensure that the concrete is plastic. Retempering with water is not allowed. Comply with ACI 305R.

3.04 FINISH OF FORMED SURFACES

A. Rough Form Finish: Provide where formed concrete surfaces are not exposed to view. Tie holes and surface imperfections shall be repaired and patched and fins and other projections exceeding ¼ inch in height rubbed down or chipped off.

3.05 FINISH OF HORIZONTAL SURFACES

A. At tops of foundation walls and grade beams finish with a texture matching adjacent formed surfaces unless otherwise indicated.

3.06 SLAB FINISHES

A. Float Finish: Begin floating when surface water has disappeared and when concrete has stiffened sufficiently to permit operation of power-driven or hand floats. Consolidate surface with power-driven floats, or by hand-floating if area is small or inaccessible to power units. Check and level surface plane to a tolerance not exceeding ¼ inch in 10 feet when tested with a 10 foot straightedge.

B. Scratch Finish: Apply scratch finish to slab surfaces that are to receive floor topping. Roughen surface before final set, using stiff brushes, or brooms.

C. Trowel Finish: Apply trowel finish to all slab surfaces unless noted otherwise. After floating, begin first trowel finish using a power-driven or hand trowel. Finish concrete surface by a final hand-trowel operation, free of trowel marks, and uniform in texture and appearance. The final surface finish for slabs-on-grade shall have a minimum FF = 25 and a minimum FL = 20 per ACI requirements. The final surface finish for elevated slabs shall have a minimum FF = 25. Verify with Architectural requirements.

D. Broom Finish: Apply on exterior slabs, ramps, steps, and sidewalks. Immediately after concrete has received a float finish, draw a broom or burlap belt across the surface to give a coarse transverse scored texture.

3.07 CONCRETE CURING AND PROTECTION

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Start initial curing as soon as free water has disappeared from concrete surface after placing and finishing. Continue curing for at least 7 days.

B. Moisture-retaining Cover curing: All interior concrete slabs, except exposed integrally colored concrete slabs, are to be cured with a moisture retaining cover for the first 7 days. After that time, the cover shall be removed and the slab should be allowed to dry. Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width with sides and ends lapped at least 3 inches and sealed. Repair any holes or tears in cover during curing period.

C. Curing compound: At contractor's option, exterior concrete slabs may be cured using curing compound. All vertical concrete (walls, beams, etc…) shall be cured using curing compound – apply compound to the vertical surface as soon as the forms are removed. Apply curing compound uniformly in accordance with the manufacturer's printed instructions. Curing compound shall NOT be used on interior slabs, except exposed integrally colored concrete slabs.

D. Exposed integrally colored concrete slabs: Use curing compound recommended by the concrete supplier. See general structural notes for additional requirements for polished color slabs.

3.08 CONCRETE SURFACE REPAIRS

A. Patching Surface Imperfections: Remove loose material and patch surface imperfections and holes left by tie rods with cement mortar. Surface imperfections include honeycomb, excessive air voids, sand streaking and cracks.

3.09 FOR EXPOSED-TO-VIEW SURFACES

A. Blend white portland cement and standard portland cement so that, when dry, patching mortar will match color surrounding. Provide test areas at inconspicuous location to verify mixture and color match before proceeding with patching. Compact mortar in place and strike-off slightly higher than surrounding surface.

1.10 FIELD QUALITY CONTROL

A. The Owner shall employ the services of a qualified testing laboratory to perform tests and submit test reports.

B. Sampling Fresh Concrete: ASTM C 172.

C. Slump: ASTM C 143; one test for each set of compressive strength test specimens.

D. Air Content: ASTM C 173 or C 231 for each set of compressive strength test specimens.

E. Concrete Temperature: Test hourly when air temperature is 40 degrees F. and below, when 80 degrees F and above; and when compression test specimens are made.

F. Compression Test Specimen: ASTM C 31, one set of 4 standard cylinders for each compressive strength test, unless otherwise directed. Mold and store cylinders for laboratory cured test specimens except when field cure test specimens are required. Mold one set of standard cylinders for volume of concrete specified below or fraction thereof.

1.	Slabs on Grade or Metal Deck	30 cubic yards
2.	Footings and stem walls	50 cubic yards
3.	All other locations (unless noted otherwise)	30 cubic yards

G. Compressive Strength Tests: ASTM C 39; test 1 specimen at 7 days, 2 specimens at 28 days, and retain one specimen in reserve for later testing. Additional Tests: The testing laboratory will make additional tests of in-place concrete when test results indicate specified concrete strengths and other characteristics have not been attained in the structure as directed by the Architect. The testing laboratory may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42 or by other methods as directed by the Architect or Engineer. The Owner shall pay for such tests conducted, and any other additional testing as may be required, when unacceptable concrete is verified.

H. Granular Base Course: ASTM C 136 and ASTM D 4318 for every 500 square yards of building slab area.

END OF SECTION

SECTION 03 3511 - CONCRETE FLOOR FINISHES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Surface treatments for concrete floors and slabs.

1.02 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

1.03 MOCK-UP

A. For coatings, construct mock-up area under conditions similar to those that will exist during application, with coatings applied.

B. Mock-Up Size: 10 feet square.

C. Locate where directed.

D. Mock-up may remain as part of the work.

1.04 FIELD CONDITIONS

A. Maintain light level equivalent to a minimum 200 W light source at 8 feet above the floor surface over each 20 foot square area of floor being finished.

B. Follow all manufacturer required field condition requirements.

PART 2 PRODUCTS

2.01 CONCRETE FLOOR FINISH APPLICATIONS

A. Unless otherwise indicated, all concrete floors are to be finished using slip resistant coating.

B. High Gloss Clear Sealer:

C. Slip Resistant Coating: High gloss clear sealer with plastic aggregate.
   1. Use at following locations: Mechanical rooms and other areas.

D. Polyaspartic Aliphatic Polyurea Coating:
   1. Use at following locations: Vehicle Bays.

2.02 COATINGS

A. Concrete Stain or Dye: Translucent, penetrating compound for interior or exterior use; must be finished with a topical sealer.
   1. Composition: _____.
   2. Number of Coats: Minimum of two.

3. VOC: 100 g/L or less.

B. High Gloss Clear Coating: Transparent, non-yellowing, water- or solvent-based coating.
1. Composition: Acrylic polymer-based.

C. Plastic Aggregate: Finely ground polymer for addition to coatings for slip resistance.

PART 3 EXECUTION

3.01 GENERAL

A. Apply materials in accordance with manufacturer's instructions.

3.02 COATING APPLICATION

A. Verify that surface is free of previous coatings, sealers, curing compounds, water repellents, laitance, efflorescence, fats, oils, grease, wax, soluble salts, residues from cleaning agents, and other impediments to adhesion.

B. Protect adjacent non-coated areas from drips, overflow, and overspray; immediately remove excess material.

C. Apply coatings in accordance with manufacturer's instructions, matching approved mock-ups for color, special effects, sealing and workmanship.

END OF SECTION

SECTION 04 2200

REINFORCED UNIT MASONRY

PART 1 GENERAL

1.01 WORK INCLUDED

A. This section includes the construction of reinforced hollow core unit masonry, masonry veneer and special shapes. It includes all split face units and smooth face units, as well as masonry mortar and grout.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Concrete Reinforcement - Section 03 20 00

B. Division 07 Section “Water Repellents” for water repellents applied to unit masonry assemblies.

C. Division 07 Section “Sheet Metal Flashing and Trim” for exposed sheet metal flashing.

D. Division 07 Section “Fire stopping” for fire stopping at tops of masonry walls and at openings in masonry walls.

E. Division 08 Section “Louvers and Vents” for wall vents (brick vents).

F. Products furnished, but not installed, under this Section include the following:

1. Anchor sections of adjustable masonry anchors for connecting to structural frame, installed under Division 05 Section “Structural Steel” and Division 13 Section “Metal Building Systems”.

G. Products installed, but not furnished, under this Section include the following:

1. Cast-stone trim, furnished under Division 04 Section “Cast Stone”.
2. Steel lintels for unit masonry, furnished under Division 05 Section “Metal Fabrications”.
3. Manufactured reglets in masonry joints for metal flashing, furnished under Division 07 Section “Sheet Metal Fabrications”.
4. Hollow-metal frames in unit masonry openings, furnished under Division 08 Section “Steel Doors and Frames”.

1.03 QUALITY ASSURANCE

A. Reference Standards

1. ASTM International (ASTM)

a.	ASTM A 615/ A615M-09b	Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
b.	ASTM C 90-11a	Standard Specification for Load bearing Concrete Masonry Units
c.	ASTM C 780-15a	Standard Test Methods for Preconstruction and Construction Evaluation of Mortars for Pain and reinforced Masonry
d.	ASTM C 270-10	Standard Specification for Mortar for Unit Masonry
e.	ASTM C 476-10	Standard Specification for Grout for Masonry
f.	ASTM C 1019-11	Standard Test Method for Sampling and Testing Grout

2. American Concrete Institute (ACI)

a.	ACI 530.1-02	Specification for Masonry Structures

1.04 SUBMITTALS

A. Product Data: Submit sample of exposed masonry unit of each color and texture to be used to complete the work. Submit copies of test reports performed within last 12 months for representative specimens to be used in accordance with ASTM C 140 for strength, absorption and moisture content, and ASTM C 426 for drying shrinkage.

B. Test Reports: Submit copies of test reports for masonry units, mortar and grout.

1.05 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Store masonry units above ground on level platforms, which allows air circulation under stacked units.

B. Cover and protect against wetting prior to use.

C. Handle units on pallets or flat bed barrows.

D. Store cementitious ingredients in weather-tight enclosures.

E. Waste Management and Disposal: As specified in Division 01 Section “Construction Waste Management” and as follows:

1. Separate and recycle waste materials in accordance with the Waste Management Plan and to the maximum extent economically feasible.
    a. Fold up metal banding; flatten and place in designated area for recycling.
    b. Collect wood packing shims and pallets; place in designated area.
2. Recycling: Undamaged, excess masonry materials are Contractor’s property and shall be removed from the Project site for his use.
3. Disposal as Fill Material: Dispose of clean masonry waste, including broken masonry units, waste mortar, and excess or soil contaminated sand, by crushing and mixing with fill material as fill is placed.
    a. Crush masonry waste to less than 2 inches in greatest dimension.
    b. Mix masonry waste with at least 2 parts specified fill material for each part masonry waste. Fill material is specified in Division 31 Section “Earth Moving”.
    c. Do not dispose of masonry waste as fill within 18 inches of finished grade.
4. Excess Masonry Waste: Remove excess, clean masonry waste that cannot be used as fill, as described above, and other masonry waste and legally dispose of off Owner’s property.

PART 2 PRODUCTS

2.01 MATERIALS

A. Hollow Core Split Faced Scored Units: ASTM C 90.

B. Hollow Core Units: ASTM C90.

C. Aggregate: See architectural for exposed block.

D. Aggregate: Natural color at concealed block.

E. Mortar: ASTM C 270 “Standard Specification for Mortar for Unit Masonry,” Type S, f’c = 1800psi.

F. Grout: ASTM C 476 “Standard Specification for Grout for Masonry.”

G. Cell Reinforcing: ASTM A 615 “Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement,” Grade 60. Comply with Section 03 20 00.

H. Bond Beam and Lintel Reinforcing: ASTM A 615, Grade 60. Comply with Section 03 20 00.

I. Joint Reinforcing: Hot Dipped Galvanized, Standard Ladder Type 9 Gage Wire Dur-O-Wal or approved equal.

J. Control Joint Material: Rubber, neoprene or PVC joint material for use with standard sash block by Dur-O-Wal or approved equal.

K. Vertical Bar Positioner: Steel by Dur-O-Wal or approved equal.

L. Mortar Plasticizer: Easy Spread by American Colloid Company or approved equal.

PART 3 EXECUTION

3.01 GENERAL

A. Provide jamb, header, lintel, bond beam, etc. units as required to complete the work. Lay only dry and unfrozen masonry units.

B. All exposed masonry shall be scoria aggregate, split face, scored finish unless noted otherwise on the drawings. Masonry not exposed to view may be smooth finished.

C. Discard any broken, chipped, or discolored masonry units.

D. Use masonry saws to cut and fit masonry units.

E. Lay units in running bond pattern with vertical joints located at center of masonry units in alternate course below.

F. Set units plumb, true to line and with level courses accurately spaced.

G. Adjust masonry unit to final position while mortar is soft and plastic.

H. Anchors, flashing accessories and similar devices shall be built in as masonry progresses.

3.02 MORTAR

A. Mix all cementitious materials and sand in a mechanical batch mixer for a minimum of 5 minutes. Adjust the consistency of the mortar to the satisfaction of the mason, but add only as much water as is compatible with convenience in using the mortar. If the mortar begins to stiffen from evaporation or from absorption of a pat if the mixing water, re-temper the mortar immediately by adding water, and remix the mortar.

B. Mortar for exterior walls shall have waterproofing added in accordance with the manufacturer's recommendations.

C. Addition of admixtures or re-tempering of mortar at the mixer to extend its use will not be permitted.

3.03 RE-TEMPERING

A. All mortar shall be used within 2-1/2 hours of initial mixing and no mortar shall be used after it has begun to set. Re-tempering of mortar in which setting has saturated will not be permitted. However, mortar shall be re-tempered, except as above qualified, as necessary to keep it plastic.

3.04 JOINTS

A. Provide joints 3/8 inch nominal thickness and tooled unless shown otherwise on drawings.

B. Construct uniform joints.

C. Units shall be placed with sufficient pressure to extrude mortar and provide a tight joint.

3.05 REINFORCEMENT

A. Reinforcement shall be secured against displacement prior to grouting at a spacing not greater than 4 feet.

B. Provide rebar lap lengths specified in the General Structural Notes on the drawings. Provide 6 inches minimum lap for all ladder type joint reinforcing.

3.06 GROUTING

A. Grout all cells, which are below grade.

B. Grout lintel blocks over masonry openings and each jamb of masonry openings.

C. Grout pours shall not exceed 5 feet in height.

D. Grout all cells solid, which contain reinforcing.

Grout shall have a slump range of 8 to 11 inches tested in accordance with ASTM C143.

Consolidate grout pours 12 inches or less in height by mechanical vibration or by puddling. Consolidate pours exceeding 12 inches in height by mechanical vibration and reconsolidate by mechanical vibration after initial water loss and settlement has occurred. Typically this occurs within 2-4 minutes of placement of grout.

Place grout within 1-1/2 hours from introducing water in the mixture and prior to initial set.

3.07 POINTING AND CLEANING

A. At completion of unit masonry work, fill holes in joints and tool.

B. Cut out and repoint defective joints.

C. Dry brush masonry surface after mortar has set, at end of each day's work and after final pointing.

D. Leave work and surrounding surfaces clean and free of mortar spots and droppings.

3.08 PROTECTION OF WORK

A. Protect sills, ledges, and offsets from mortar drippings or other damage during construction.

B. Remove misplaced mortar or grout immediately.

C. Cover top of walls with non-staining waterproof coverings when work is not in progress.

D. Provide adequate bracing during construction to prevent damage from wind loads.

3.09 WEATHER CONDITIONS

A. Do not place concrete masonry units when air temperature is below 20 degrees F.

B. For temperatures between 20 degrees F and 40 degrees F, sand and mixing water shall be heated to produce mortar temperatures between 40 degrees F and 120 degrees F. Mortar shall be maintained above 32 degrees F during placement.

C. Masonry shall be protected from freezing for 24 hours after placement.

3.10 FIELD QUALITY CONTROL

A. The Owner shall employ the services of a qualified testing laboratory to perform tests and submit test reports.

B. Concrete Masonry Units (CMU): Test in accordance with ASTM C 140. “Standard Test Methods of Sampling and Testing Concrete Masonry Units.” Six units shall be sampled and tested for each lot of 10,000 units or less delivered to the job site. Twelve units shall be sampled from each lot of more than 10,000 units and less than 100,000 units.

C. Mortar: By proportions according to ASTM C 780 “Standard Test Method for Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Masonry.”

D. Grout: Mold and test 4 test specimens in accordance with ASTM C 1019 “Test Method for Sampling and Testing Grout” from each day’s grout placement. Test grout slump prior to each day’s grouting process. Submit slump value with test specimen results. See General Structural Notes for required strength.

END OF SECTION

SECTION 05 1000

STRUCTURAL STEEL

PART 1 GENERAL

1.01 WORK INCLUDED

A. This section includes the fabrication and erection of structural steel.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Steel Joists - Section 05 21 00

B. Metal Deck - Section 05 30 00

1.03 QUALITY ASSURANCE

A. Qualifications of Fabricator: Fabricator shall have a minimum of 5 years experience in the fabrication of structural steel of structures of similar size. Fabricator shall have AISC or IAS certification or other certification as approved by the building official and the engineer of record. If the fabricator does not have approved certification, special inspection shall be done on the fabrication process and on the fabricated material as required by Section 1704.2, Inspection of Fabricators of the International Building Code. The non-certified fabricator shall engage a special inspector that meets the requirements of IBC section 1704.1 and is acceptable to the building official and the engineer of record. Provide documentation verifying certification or provide special inspector information for approval prior to issuance of a building permit.

B. Qualifications of Erector: Erector shall have a minimum of 5 years experience in the erection of structural steel of structures of similar size.

C. Qualifications of Field Welders: Welders shall be certified in accordance with AWS D1.1 within the last 12 months.

D. Reference Standards:

1. ASTM International (ASTM)

a.	ASTM A 36/ A36M-08	Standard Specification for Carbon Structural Steel
b.	ASTM A 53/ A 53M-10	Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-coated Welded and Seamless
c.	ASTM A 61/ A6M-11	Standard Specification for General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling.
d.	ASTM A 307-10	Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength
e.	ASTM A 325-10	Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength
f.	ASTM A 490-11	Specification for Structural Bolts, Alloy Steel, Heat Treated, 150 ksi Minimum Tensile Strength
g.	ASTM A 500/ A500M-10a	Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
h.	ASTM A 992/ A 992M-11	Standard Specification for Structural Steel Shapes
i.	ASTM C 1107/ C1107M-11	Standard Specification for Packaged Dry, Hydraulic-Cement Grout (non-shrink)
j.	ASTM F1554-07ae1	Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength.

2. American Welding Society (AWS), latest edition.

a. AWS D1.1 Structural Welding Code-Steel

3. American Institute of Steel Construction (AISC), Steel Construction Manual, latest edition.
   a. Specification for Structural Steel Buildings
   b. AISC Code of Standard Practice
   c. Specification for Structural Joints Using ASTM A 325 or A 490 Bolts.

1.04 SUBMITTALS

A. Shop Drawings: Submit shop drawings including erection plans, complete details and schedules for fabrication and assembly of structural steel members. Include details of cuts, connections, camber, holes, and other pertinent data. Indicate welds by standard AWS symbols, and show size, length, and type of each weld. Shop drawings shall not be made by reproduction of the Contract Drawings.

B. Provide setting drawings and directions for installation of anchor bolts and other anchorages to be installed by others.

C. Welder Certification: Submit affidavit stating that all welders are certified in accordance with AWS and provide copies of welder's certificates.

1.05 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Support structural steel above ground on skids, pallets, platforms, or other supports.

B. Protect steel from damage.

C. Store packaged materials in original unbroken package or container.

D. Do not store materials on structure in a manner that might cause distortion or damage to members or supporting structures.

E. Replace damaged shapes or members.

F. Waste Management and Disposal; As specified in Division 01 Section "Construction Waste Management" and as follows: Collect cut offs and scrap and place in designated area for recycling in accordance with the Waste Management Plan and local recycler standards.

PART 2 PRODUCTS

2.01 MATERIALS

A. All Wide Flange Shapes shall conform to ASTM A 992, Grade 50 unless noted otherwise.

B. All Angles, Channels, Plates, and Bars: ASTM A 36.

C. Structural Steel Pipe: ASTM A 53, Type E or S, Grade B Fy=35 ksi

D. Rectangular or Square Hollow Structural Section: ASTM A 500, Grade B, Fy = 46 ksi.

E. Round Hollow Structural Sections: ASTM A 500, Grade B, Fy-42 ksi.

F. Anchor Bolts: ASTM F1554, Grade 36

G. High Strength Tension Control Threaded Fasteners: Meet requirements of ASTM A 325 or ASTM A 490.

H. Headed Anchor Shear Studs: By the Nelson Division of TRW.

I. Welding Electrodes: E 70 Series.

J. Shop Primer Paint: Fabricators standard rust inhibitive primer.

K. Non-Metallic, Non-Shrink Grout: Meets the requirements of ASTM C 1107.

L. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive, non-staining, mixed with water to consistency suitable for application and a 30-minute working time. Grout shall have a minimum 28 day compressive strength of 6,000 psi.

1. Subject to compliance with requirements, provide products by one of the following or an approved equal:
   a. Five Star Fluid Grout 100; Five Star Products, Inc., Fairfield, Connecticut.

b. Crystex; L&M Construction Chemicals, Inc. Omaha, Nebraska.

c. Sure-Grip High Performance Grout; Dayton superior Corp., Miamisburg, Ohio.

d. Sonnogrout 10K; Sonneborn Building Products, Shakopee, Minnesota.

e. Sealight Pac-It Grout; W.R. Meadows, Inc., Hampshire, Illinois.

f. Enduro 50; Conspec Marketing & Manufacturing Co., Inc, Kansas City, Kansas.

2.02 FABRICATION

A. Fabrication shall be in accordance with the AISC "Code of Standard Practice for Buildings and Bridges".

B. Connections: Weld or bolt shop connections as indicated on the approved shop drawings. Design connections to support reactions and forces where indicated on the drawings.

C. Shop Welds: Shall be visually inspected by the Fabricator's quality control department.

2.03 SHOP PAINTING

A. General: Shop paint structural steel, except those members or portions of members to be embedded in concrete, mortar or to receive sprayed on fireproofing. Paint embedded steel, which is partially exposed on exposed portions and initial 2 inch of embedded areas only.

B. Do not paint surfaces, which are to be welded or high-strength bolted with friction-type connections.

C. Surface Preparation: After inspection and before shipping, clean steel work to be painted. Remove loose rust, loose mill scale, and spatter, slag or flux deposits. Clean steel in accordance with Steel Structures Painting Council (SSPC) as follows:

1. SP-1 "Solvent Cleaning"
2. SP-2 "Hand Tool Cleaning"
3. SP-3 "Power Tool Cleaning". For Architecturally Exposed Structural Steel, AESS, see Architectural drawings for locations.

D. Painting: After surface preparation, apply structural steel primer paint in accordance with manufacturer's instructions. Provide one coat.

PART 3 EXECUTION

3.01 COORDINATION

A. Field Measurements: Verify all elevations, locations, and dimensions of surfaces to receive structural steel.

B. Anchor Bolts and Other Embedded Items: Verify locations and positions of anchor bolts and other embedded items used to support structural steel.

All Anchor bolts for column base plates, anchors and bearing plates for beams shall be located prior to installation by a Registered Professional surveyor. The Professional Surveyor shall use project control points, such as bench marks, grid lines, or building corners established and accurately maintained by the General Contractor for vertical and horizontal control of location. Templates shall be used to locate groupings of bolts or anchors and shall be confirmed as to orientation and hole geometry accuracy.

Anchor bolts and bearing plates with anchors shall be stabilized against movement, vertical and horizontal, prior to and during concrete casting of concrete supporting these devices.

Upon completion of the concrete casting the Professional Surveyor shall verify vertical and horizontal locations and orientation of anchor bolts or bearing plates with anchors. A report shall be furnished to the Engineer of Record (through the General Contractor and Architect) noting non compliant locations.

The EOR, will furnish remedial actions required to correct the non compliant anchor bolt or bearing plate locations. Allow ten days for the EOR's report on remedial actions necessary.

It shall be the General Contractor's responsibility to have this work performed.

C. Correct any unsatisfactory conditions prior to erection of structural steel.

3.02 PREPARATION

A. Clean surfaces to receive structural steel prior to erection.

3.03 ERECTION

A. General: Erect structural steel in accordance with AISC "Code of Standard Practice for Steel Buildings and Bridges".

B. Field Assembly: Assemble structural steel accurately to the lines and elevations shown on the drawings. Align and adjust components accurately before fastening.

C. Temporary Bracing: Provide temporary bracing or guys to secure structural steel against wind, seismic, or construction loads. It is the responsibility of the Contractor to maintain stability of the structure during erection.

D. Field Bolted Connections: Install high strength tension control bolts in accordance with AISC Specifications for Structural Joints Using ASTM A325 and A490 Bolts and the manufacturer's instructions. Where clearance within a connection does not permit the use of tension control bolts, standard A325 bolts shall be used and inspected in accordance with the AISC Specification for Structural Joints.

E. Field Welding: Perform all welds in accordance with AWS.

F. Welded Connections: Field welds shall be visually inspected according to AWS D1.1/D1.1M.

   a. In addition to visual inspection, field welds will be tested and inspected according to AWS D1.1/D1.1M and the following inspection procedures, at testing agency’s option:

      i. Liquid Penetrant Inspection: ASTM E 165.

      ii. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration will not be accepted.

      iii. Ultrasonic Inspection: ASTM E 164.

      iv. Radiographic Inspection: ASTM E 94

G. Gas Cutting: Do not use gas-cutting torches in field to cut structural framing.

H. Do not enlarge unfair holes by burning. Ream holes that must be enlarged to admit bolts.

I. Field Touch-up Painting (Primer): Paint all exterior exposed bolts, washers, and nuts after connections have been tightened and checked. Paint all exterior exposed field welds. Paint all exterior exposed abrasions in shop coat. Use same paint as for shop painting.

J. Grout Placement: Comply with the manufacturer's instructions.

K. Tighten anchor bolts after supported members have been positioned and plumbed.

END OF SECTION

SECTION 05 2100

STEEL JOISTS

PART 1 GENERAL

1.01 WORK INCLUDED

A. This section includes the fabrication and erection of open web steel joists.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Structural Steel - Section 05 10 00

1.03 QUALITY ASSURANCE

A. Qualification of Fabricator: Fabricator shall be a member of the Steel Joist Institute.

B. Qualification of Field Welders: Welders shall be certified in accordance with AWS D1.1 within the last 12 months.

C. Reference Standards:

1. ASTM International, latest versions

   a. ASTM A 307 Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength

2. Steel Joist Institute (SJI) Standard Specifications, Load Tables and Weight Tables for Steel Joists and Joist Girders, 4th Edition, 2005.

   a. Standard Specifications and Load Tables, Open Web Steel Joists, K-Series. SJI, 2010

   b. Standard Specifications and Load Tables for Longspan Steel Joists, LH-Series and Deep Longspan Steel Joists, DHL Series SJI, 2010

1.04 SUBMITTALS

A. Certification: Submit manufacturer's certification that joists comply with SJI Specifications.

B. Shop Drawings: Submit detailed drawings showing layout of joist units, special connections, jointing and accessories. Include mark, number, type, location and spacing of joists and bridging. Shop Drawings shall not be made by reproduction of the Contract Drawings. Joists designated with “SP” shall be designed by the joist manufacturer that is registered in the state of the project location. Submittal shall contain stamped calculation and joist load diagrams.

1.05 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Support structural steel above ground on skids, pallets, platforms, or other supports

B. Protect steel from damage.

C. Store packaged materials in original unbroken package or container.

D. Do not store materials on structure in a manner that might cause distortion or damage to members or supporting structures.

E. Replace damaged shapes or members.

F. Waste Management and Disposal: As specified in Division 01 Section “Construction Waste Management” and as follows:

1. Collect off cuts and scrap and place in designated area for recycling in accordance with the Waste Management Plan and local recycler standards.

PART 2 PRODUCTS

2.01 MATERIALS

A. Steel: Comply with SJI Specifications.

B. Unfinished Threaded Fasteners: ASTM A 307, Grade A, regular hexagon type, low carbon steel.

C. Steel Prime Paint: Comply with SJI Specifications.

2.02 FABRICATION

A. Fabricate steel joists in accordance with SJI Specification.

B. Extended Ends: Provide extended ends on joists as required complying with applicable SJI Specifications and load tables.

C. Ceiling Extensions: Provide ceiling extensions in areas having ceilings attached directly to joist bottom chord. Provide an extended bottom chord element of sufficient strength to support ceiling construction. Extend ends to within ½ inch of finished wall surface unless otherwise indicated.

D. Bridging: Provide horizontal or diagonal type bridging for "open web" joists, as required by SJI Specifications.

E. Shop Painting: Remove loose scale, heavy rust, and other foreign materials from fabricated joists and accessories before application of shop paint.

F. Apply one shop coat of primer paint to steel joists and accessories, by spray, dipping, or other method to provide a continuous dry paint film thickness of not less than 0.50 mil.

PART 3 EXECUTION

3.01 COORDINATION

A. Verify all elevation locations and dimensions of surfaces to receive steel joists. Furnish plates, angles, etc. as required to secure steel joists.

3.02 ERECTION

A. Place and secure steel joists in accordance with SJI Specifications, approved shop drawings, and as herein specified.

B. Placing Joists: Do not start placement of steel joists until supporting work is in place and secured. Place joists on supporting work, adjust and align in accurate locations and spacing before permanently fastening.

C. Bridging: Install bridging simultaneously with joist erection, before construction loads are applied. Anchor ends of bridging lines at top and bottom chords where terminating at walls or beams.

D. Fastening Joists: Field weld joists to supporting steel framework in accordance with SJI Specifications for type of joists used. Coordinate welding sequence and procedure with placing of joists unless noted on contract drawings. Bolt joists to supporting steel framework where required by SJI Specifications.

E. Touch-Up Painting: After joist installation, paint field bolt heads and nuts, and welded areas, abraded or rusty surfaces on joists and steel supporting members. Wire brush surfaces and clean with solvent before painting. Use same type of paint as used for shop painting.

END OF SECTION

SECTION 05 3000

METAL DECKING

PART 1 GENERAL

1.01 WORK INCLUDED

A. Provide all metal decking complete in place as shown on the drawings, specified herein, and needed for a complete and proper installation.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Structural Steel - Section 05 10 00

B. Steel Joists - Section 05 21 00

C. Cold-Formed Metal Framing - Section 05 40 00

1.03 QUALITY ASSURANCE

A. Reference Standards:

1. Qualification of Field Welders: Welders shall be certified in accordance with AWS D1.3 within the last 12 months.

2. ASTM International.

a.	ASTM A 653/ A653M-11	Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
b.	A 1008/ A 1008M-11	Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low Alloy, High-Strength Low Alloy with Improved Formability
c.	ASTM A 1011/ A 1011M-10	Standard Specification for Steel, Sheet and Strip, Hot Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low Alloy with Improved Formability, and Ultra-High-Strength. American Welding Society (AWS), latest edition.
d.	D1.3	Structural Welding Code - Sheet Steel

3. Steel Deck Institute.

a.	SDI	Design Manual for Floor Decks, Form Decks and Roof Decks
b.	SDI	Diaphragm Design Manual Third Edition

1.04 SUBMITTALS

A. Product Data: Submit manufacturer's specifications and installation instructions for each type of decking and accessories.

B. Shop Drawings: Submit detailed drawings showing layout and types of deck panels, anchorage details, and conditions requiring closure panels, supplementary framing, sump pans, cant strips, cut openings, special jointing or other accessories. Shop Drawings shall not be made by reproduction of the Contract Drawings.

1.05 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Support metal deck above ground on skids, pallets, platforms or other supports.

B. Protect metal deck from damage.

C. Store packaged materials in original unbroken package or container.

D. Waste Management and Disposal: As specified in Division 01 Section “Construction Waste Management” and as follows:

1. Collect off cuts and scrap and place in designated area for recycling in accordance with the Waste Management Plan and local recycler standards.

PART 2 PRODUCTS

2.01 MATERIALS

A. Metal Roof Deck: ASTM A 1008, Grade C. See plans for type, size and finish. Metal deck used in fire rated assemblies shall meet the requirements of UL. The UL mark on the product will be accepted as evidence of compliance.

B. Metal Floor Deck: ASTM A 1011 with galvanized finish. See plans for type and size.

C. Finishes:

1. Painted: Manufacturer's baked-on, rust-inhibitive paint.
2. Galvanized: Conform to ASTM A 653, G60.

PART 3 EXECUTION

3.01 COORDINATION

A. All edge angle shall be in place with proper attachment prior to installation of metal deck. All roof and floor opening frames shall be installed prior to deck installation.

3.02 INSTALLATION

A. General: Install deck units and accessories in accordance with manufacturer's recommendations and final shop drawings, and as specified herein. Locate deck bundles to prevent overloading of structural members.

B. Place deck units on supporting steel framework and adjust to final position with ends accurately aligned and bearing on supporting members before being permanently fastened. Do not stretch or contract side lap interlocks.

C. Place deck units in straight alignment for entire length of run.

D. Place deck units flat and square secured to adjacent framing without warp or excessive deflection.

E. Lap ends of deck units a minimum of 2 inches over supports.

F. Place deck units to permit proper attachment to the perimeter deck angle.

G. Do not use deck units for storage or working platforms until permanently secured.

H. Cut and neatly fit deck units and accessories around other work projecting through or adjacent to the decking, as shown.

I. Fasten deck units to steel supporting members as shown on the structural drawings.

J. Fasten side laps of units as called for on the structural drawings.

K. Care shall be exercised in the selection of electrodes and amperage to provide positive welds and to prevent high amperage blowholes.

L. Comply with AWS D1.3 requirements and procedures.

M. Provide additional metal reinforcement and closure pieces as required for strength, continuity of decking and support of other work shown.

N. Install closure strips at all locations as recommended by the manufacturer to provide a complete installation.

O. Provide cleaning and touch-up painting of field welds, abraded areas and rust spots, as required for all exposed areas after erection and before proceeding with field painting.

END OF SECTION

SECTION 05 4000

COLD FORMED METAL FRAMING

PART 1 GENERAL

1.01 WORK INCLUDED

A. This section includes all lightgage studs, joists and track, 20 gage or heavier, including bridging, and related accessories as indicated on the Contract Drawings and specified herein.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Structural Steel - Section 05 10 00

B. Steel Joists - Section 05 21 00

1.03 QUALITY ASSURANCE

A. Reference Standards:

1. American Iron and Steel Institute (AISI) North American Specification for the Design of Cold-Formed Steel Structural Members, 2001.
2. American Welding Society of (AWS) D1.3, Structural Welding Code-Sheet Steel.
3. ASTM International.

a.	ASTM A 653/ A653M-11	Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
b.	A 1008/ A 1008M-11	Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low Alloy, High-Strength Low Alloy with Improved Formability
c.	ASTM A 1011/ A 1011M-10	Standard Specification for Steel, Sheet and Strip, Hot Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low Alloy with Improved Formability, and Ultra-High-Strength

4. Qualifications of Erector: Erector shall have a minimum of 5 years experience in the erection of structural steel of structures of similar size.
5. Qualifications of Field Welders: Welders shall be certified in accordance with AWS D1.1 within the last 12 months.

1.04 SUBMITTALS

A. Submit manufacturer's product information and installation instructions for each item of lightgage framing. Submit shop drawings for all prefabricated lightgage systems.

1.05 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Protect metal framing units from rusting and damage. Deliver to project site in manufacturer's unopened containers or bundles, fully identified with name, brand, type, and grade. Store off ground in a dry ventilated space or protect with suitable waterproof coverings.

B. Waste Management and Disposal: As specified in Division 01 Section “Construction Waste Management” and as follows:

1. Collect off cuts and scrap and place in designated area for recycling in accordance with the Waste Management Plan and local recycler standards.

PART 2 PRODUCTS

2.01 MATERIALS

A. Metal Framing:

1. All 12, 14, and 16 gage steel studs and joists shall be formed from steel that meets the requirements of one of the following standards with a minimum yield strength of 50,000 psi:

Painted Material - ASTM A 1011, Grade 50.

a. Galvanized Material - ASTM A 653 Grade 50.

2. All 18 and 20 gage steel studs and joists; all track, bridging and accessories shall be formed from steel that meets the requirements of one of the following with a minimum yield strength of 33,000 psi:

Painted Material - ASTM A 1008, Grade C.

a. Galvanized Material - ASTM A 653.

B. Material Finishes: All stud and joist components shall be primed with paint meeting the performance requirements of TT-P-1636C, or shall be formed from steel having a G-60 galvanized coating or better.

2.02 FABRICATION

A. Framing components may be prefabricated into panels prior to erection. Prefabricated panels shall be square, with components attached to prevent racking. Handling and lifting of panels shall be done in a manner as to not cause distortion in any member.

B. All framing components shall be cut squarely for attachment to perpendicular members, or as required for an angular fit against abutting members. Members shall be held positively in place until properly fastened.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install metal framing systems in accordance with manufacturer's printed instructions and recommendations, unless otherwise indicated on Contract Drawings.

B. Install and align tracks accurately to layout at base and tops of studs. Secure tracks as indicated on Contract Drawings. Provide fasteners at corners and ends of tracks.

C. Install supplementary framing, blocking and bracing in metal framing system to support fixtures, equipment, etc. Comply with stud manufacturer's recommendations and industry standards, considering weight and loading of each item.

D. Secure studs to top and bottom tracks by welding at both inside and outside flanges or with a minimum of 2-#8 self tapping screws (one per flange) up to 16 gage material and 2-#10 self tapping screws (one per flange) for 14 gage and thicker, unless noted otherwise.

E. Frame wall openings larger than 2 foot-0 inches square with double studs at each jamb of frame except where more than 2 are either shown or indicated in manufacturer's instructions. Install tracks and jack studs above and below wall openings. Anchor tracks to jamb studs with stud shoes or by welding, and space jack studs same as full-height studs of wall. Secure stud system wall opening frame in manner indicated.

F. All components of build-up stud sections, including jack studs, full height studs, columns, headers, etc. shall be welded together with utilizing 1/8” fillet welds 1” long at 12” on center along the full height of each flange to flange connection unless noted otherwise.

G. Install horizontal bridging in stud system, spaced (vertical distance) at no more than 4 foot – 0 inches o.c. Weld at each intersection.

H. Touch-up shop-applied protective coatings damaged during handling and installation. Use compatible primer for prime coated surfaces; use galvanizing repair paint for galvanized surfaces, such as zinc-rich paint.

END OF SECTION

SECTION 05 5000
METAL FABRICATIONS

PART 1 GENERAL

1.01 DESCRIPTION OF WORK

A. Definition: Metal fabrications include items made from iron and steel shapes, plates, bars, strips, tubes, pipes and castings which are not a part of metal systems specified elsewhere.

B. Extent of metal fabrication is indicated on the Drawings and schedules.

C. Types of work in this section include metal fabrications for:

1. Rough hardware.
2. Bollards.
3. Steel pipe railings.

D. Structural steel is specified in another section within Division 5.

1.02 QUALITY ASSURANCE

A. Reference Standards: See Section 01090.

1. American Institute for Steel Construction (AISC)

a. Work shall conform to the AISC Manual of Steel Construction and the Code of Standard Practice for Steel Buildings and Bridges, except as modified by deleting the following sentence: "This approval constitutes the Owner's acceptance of all responsibility for the design adequacy of any connection designed by the fabricator in preparation of the shop drawings".

2. ASTM International

a.	ASTM A 27	Standard Specification for Steel
	A 27M-10	Castings, Carbon, for General Application
b.	ASTM A 36/	Standard Specification for Carbon-
	A36M-08	Structural Steel
c.	ASTM A 47/	Standard Specification for Ferritic Malleable
	A 47M-99	Iron Castings
d.	ASTM A 53/	Standard Specification for Pipe, Steel, Black
	A 53M-10	and Hot-Dipped, Zinc-coated Welded and Seamless
e.	ASTM A 153/	Standard specification for Zinc
	A 153M-09	Coating (Hot-Dip) on Iron and Steel Hardware
f.	ASTM A 283/	Standard Specification for Low and
	A 283M-03	Intermediate Tensile Strength Carbon Steel Plates
g.	ASTM A 307-10	Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength
h.	ASTM A 501-07	Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing
i.	ASTM A 1008/	Standard Specification for Steel, Sheet,
	A 1008M-11	Cold-Rolled, Carbon, Structural, High-Strength Low Alloy, High-Strength Low Alloy with Improved Formability
j.	ASTM A 1011/	Standard Specification for Steel, Sheet and

	A 1011M-10	Strip, Hot Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low Alloy with Improved Formability, and Ultra-High Strength
k.	ASTM E 935-00	Standard Test Methods for Performance of Permanent Metal Railing Systems and Rails for Buildings

B. Take field measurements prior to the preparation of shop drawings and fabrication, where possible, to ensure proper fitting of the work. Allow for trimming and fitting wherever the taking of field measurements before fabrication might delay the work. Coordinate measurements prior to the preparation of shop drawings and fabrication to ensure proper fitting of the work.

C. Shop Assembly: Preassemble items in shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.

D. Qualifications for Welding Work: Use welding processes and welding operations which qualify with AWS "Standard Qualification Procedure".

1.03 SYSTEM PERFORMANCES

A. Structural Performances: Provide assemblies which, when installed, comply with the following minimum requirements for structural performance, unless otherwise indicated.

B. Provide handrails capable of withstanding the following loads applied as indicated when tested per ASTM E 935.

1. Concentrated loads of 200 lbs. applied at any point in any direction.
2. Uniform load of 50 lbs. per linear ft. applied simultaneously in both vertical and horizontal directions.
3. Concentrated and uniform loads above need not be assumed to act concurrently.

1.04 SUBMITTALS

A. See Sections 01 33 00 and 01 78 00.

1. Catalog Data: Submit manufacturer's catalog data, specifications, and anchor details for products used in miscellaneous metal fabrications, including paint products and grout.
2. Submit shop drawings for fabrication and erection of miscellaneous metal fabrications. Include plans, elevations and details of sections and connections. Show anchorage and accessory items. Furnish templates for anchor bolt installation.
3. Where materials or fabrications are to comply with stated requirements for design loading, include structural computations, material properties and other information used in structural analysis.

B. Waste Management and Disposal: As specified in Division 01 Section “Construction Waste Management” and as follows:

1. Collect off cuts and scrap and place in designated area for recycling in accordance with the Waste Management Plan and local recycler standards.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Waste Management: Collect off cuts and scrap and place in designated area for recycling in accordance with the Waste Management Plan and local recycler standards.

PART 2 PRODUCTS

2.01 MATERIALS

A. Metals:

1. Metal Surfaces, General: For fabrication of miscellaneous metal work which will be exposed to view, use only materials which are smooth and free of surface blemishes including pitting, seam marks, roller marks, rolled trade names and roughness.
2. Use steel plates, shapes and bars complying with ASTM A 36.

3. Use bent or cold formed steel plates complying with ASTM A 283, Grade C.
4. Use steel bars and bar-size shapes complying with ASTM A 36.
5. Use hot-rolled steel tubing complying with ASTM A 501.
6. Use hot-rolled structural steel sheet complying with ASTM A 1011, Grade 33; or use cold-rolled complying with ASTM A 1008, Class 1; or grade required for design loading.
7. Use steel pipe complying with ASTM A 53, Type and grade (if applicable) as selected by fabricator and as required for design loading; black finish unless galvanizing is indicated; standard weight (schedule 40), unless otherwise indicated.
8. Use cold finished steel bars complying with ASTM A 108, Grade as selected by fabricator.
9. Use cold rolled carbon steel sheets complying with ASTM A 1008.
10. Use cast or formed metal brackets, flanges and anchors of the same type material and finish as supported rails, unless otherwise indicated.
11. Use threaded or wedge type concrete inserts with galvanized ferrous casting, either malleable iron complying with ASTM A 47 or cast steel complying with ASTM A 27. Furnish and install hot-dip galvanized bolts, washers and shims as required to comply with ASTM A 153.

B. Fasteners:
1. General: Furnish and install zinc-coated fasteners for exterior use or where built into exterior walls. Select fasteners for the type, grade and class required.
2. Use regular hexagon head type anchor bolts and nuts, ASTM A 307, Grade A.
3. Use square head type lag bolts, FS FF-B-561.
4. Use cadmium plated steel machine screws, FS FF-S-92.
5. Use flat head carbon steel wood screws, FS FF-S-111.
6. Use round plain carbon steel washers, FS FF-W-92.
7. Use anchors conforming to the following requirements:
    a. Use threaded type concrete inserts with galvanized ferrous castings, internally threaded to receive ¾ inch diameter machine bolts; either malleable iron complying with ASTM A 47, or cast steel complying with ASTM A 27 hot-dip galvanized complying with ASTM A 153.
8. Use helical spring type carbon steel lock washers, FS FF-W-84.

C. Paint:
1. Primer selected must be compatible with finish coats of paint. Coordinate selection of metal primer with finish paint requirements specified in Division 9.
2. Use high zinc dust content paint for regalvanizing welds in galvanized steel, complying with the Military Specifications MIL-P-21035 (Ships) or SSPC-Paint-20.

2.02 FABRICATION, GENERAL

A. Workmanship: Use materials of size and thickness indicated, or if not indicated, as required to produce strength and durability in the finished product for use intended. Use type of materials indicated or specified for various components of work.

B. Form exposed work true to line and level with accurate angles and surfaces and straight sharp edges. Ease exposed edges to a radius of approximately 1/32 inch unless otherwise indicated. Form bent-metal corners to the smallest radius possible without causing grain separation or otherwise impairing work.

C. Weld corners and seams continuously, complying with AWS recommendations. At exposed connections, grind exposed welds smooth and flush to match and blend with adjoining surfaces.

D. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners wherever possible. Use exposed fasteners of type indicated or, if not indicated, Phillips flathead (countersunk) screws or bolts.

E. Provide for anchorage of the type shown and required to support the structure either as shown on the Drawings or for temporary or permanent erection. Fabrication and spacing of anchoring devices shall provide adequate support for their intended use.

F. Cut, reinforce, drill and tap miscellaneous metal work as indicated to receive finish hardware and similar items.

G. Use hot-rolled steel bars for work fabricated from bar stock, unless work is indicated to be fabricated from cold finished or cold-rolled stock.

H. Galvanizing: Provide a zinc coating for those items shown or specified to be galvanized, as follows:

1. ASTM A 153 for galvanizing iron and steel hardware.
2. ASTM A 123 for galvanizing rolled, pressed and forged steel shapes, plates, bars and strip 1/8 inch thick and heavier.

I. Fabricate joints which will be exposed to weather in a manner to exclude water or provide weep holes where water may accumulate.

J. Apply shop primer to surfaces of metal fabrication except those which are galvanized or indicated to be embedded in concrete or masonry, unless otherwise indicated, and in compliance with requirements of SSPC-PA1 "Paint Application Specification No. 1" for shop painting.

K. Surface Preparation: Prepare ferrous metal surfaces to comply with minimum requirements indicated below for SSPC surface preparation specifications and environmental exposure conditions of installed metal fabrications.

1. Exteriors (SSPC Zone 1B): SSPC-SP6 "Commercial Blast Cleaning".
2. Interiors (SSPC Zone 1A): SSPC-SP3 "Power Tool Cleaning".

2.03 ROUGH HARDWARE

A. Furnish bent or otherwise custom fabricated bolts, plates, anchors, hangers, dowels and other miscellaneous steel and iron shapes as required for framing and supporting woodwork, and for anchoring or securing woodwork to concrete or other structures. Straight bolts and other stock rough hardware items are specified in Division-6 sections.

B. Fabricate items to sizes, shapes and dimensions required. Furnish malleable iron washers for heads and nuts which bear on wood structural connections; elsewhere, furnish steel washers.

2.04 LOOSE BEARING AND LEVELING PLATES

A. Provide loose bearing and leveling plates for steel items bearing on masonry or concrete construction, made flat, free from warps or twists, and of required thickness and bearing area. Drill plates to receive anchor bolts and for grouting as required. Galvanize after fabrication.

2.05 MISCELLANEOUS FRAMING AND SUPPORTS

A. Provide miscellaneous steel framing and supports which are not a part of structural steel framework, as required to complete work.

B. Fabricate miscellaneous units to sizes, shapes and profiles indicated or, if not indicated, of required dimensions to receive adjacent other work to be retained by framing. Except as otherwise indicated, fabricate from structural steel shapes and plates and steel bars of welded construction using mitered joints for field connection. Cut, drill and tap units to receive hardware and similar items.

C. Equip units with integrally welded anchors for casting into concrete or building into masonry. Furnish inserts if units must be installed after concrete is placed.

1. Except as otherwise indicated, space anchors 24 inches o.c. and provide minimum anchor units of 1- ¼ inch X ¼ inch X 8 inch steel straps.

D. Galvanize miscellaneous frames and supports where indicated.

2.06 MISCELLANEOUS STEEL TRIM

A. Provide shapes and sections indicated for profiles shown. Unless otherwise indicated fabricate units from structural steel shapes, plates and steel bars, with continuously welded joints and smooth exposed edges. Use concealed field splices wherever possible. Provide cutouts, fittings and anchorages as required for coordination of assembly and installation with other work.

2.07 STEEL PIPE HANDRAILS

A. Fabricate steel pipe handrail to meet design requirements for location indicated. Provide handrail members formed of pipe sizes and wall thickness not less than that required to support design loading.

B. Interconnect handrail members by butt-welding or welding with internal connectors, at fabricator's option, unless otherwise indicated.

1. At tee and cross intersections provide coped joints.
2. At bends interconnect pipe by means of prefabricated elbow fittings of flush radius bends, as applicable, of radiuses indicated.

C. Provide wall returns at ends of wall-mounted handrails, except where otherwise indicated.

D. Close exposed ends of pipe by welding 3/16 inch thick steel plate in place or by use of prefabricated fittings.

E. Brackets, Flanges, Fittings and Anchors: Provide wall brackets, end closures, flanges, miscellaneous fittings and anchors for attachment of handrails to other work. Furnish inserts and other anchorage devices for connecting handrails to concrete or masonry work.

PART 3 EXECUTION

3.01 PREPARATION

A. Coordinate and furnish anchorages, setting drawings, diagrams, templates, instructions, and directions for installation of anchorages, such as concrete inserts, sleeves, anchor bolts and miscellaneous items having integral anchors, which are to be embedded in concrete or masonry construction. Coordinate delivery of such items to project site.

3.02 INSTALLATION

A. General:

1. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing miscellaneous metal fabrications to in-place construction; including, threaded fasteners for concrete and masonry inserts, through-bolts, wood screws and other connectors as required.
2. Cutting, Fitting and Placement: Perform cutting, drilling and fitting required for installation of miscellaneous metal fabrications. Set work accurately in location, alignment and elevation, plumb, true and free of rack, measured from established lines and levels. Provide temporary bracing or anchors in formwork for items which are to be built into concrete or similar construction.
3. Fit exposed connections accurately together to form tight hairline joints. Do not weld, cut or abrade the surfaces of exterior units which have been hot-dip galvanized after fabrication, and are intended for bolted or screwed field connections.
4. Field welding: Comply with AWS Code for procedures of manual shielded metal-arc welding, appearance and quality of welds made, and methods used in correcting welding work.

5. Setting Loose Plates: Clean concrete bearing surfaces of any bond-reducing materials, and roughen to improve bond to surfaces. Clean bottom surface of bearing plates.

6. Set loose leveling and bearing plates on wedges, or other adjustable devices. After the bearing members have been positioned and plumbed, tighten the anchor bolts. Do not remove wedges or shims, but if protruding, cut-off flush with the edge of the bearing plate before packing with grout. Use metallic non-shrink grout in concealed locations where not exposed to moisture; use non-metallic non-shrink grout in exposed locations, unless otherwise indicated.

    a. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.

3.03 ADJUST AND CLEAN

A. Touch-up Painting: Cleaning and touch-up painting of field welds, bolted connections and abraded areas of the shop paint on miscellaneous metal is specified in a section within Division 9.

B. For galvanized surfaces: Clean field welds, bolted connections and abraded areas and apply galvanizing repair paint to comply with ASTM A 780.

END OF SECTION

SECTION 05 5100

METAL STAIRS

PART 1 GENERAL

1.01 SUMMARY – DESCRIPTION OF WORK

A. Section Includes: This Section specifies prefabricated metal stairs and railings.

B. Related Requirements:

1. Section 03 30 00 - Cast-in-Place Concrete
2. Section 05 10 00 - Structural Steel
3. Section 05 50 00 – Metal Fabrications

1.02 QUALITY ASSURANCE

A. Reference Standards:

1. ASTM International (ASTM):
    a. ASTM A36 Standard Specification for Carbon Structural Steel.
    b. ASTM A53 Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
    c. ASTM A500 Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
    d. ASTM A513 Standard Specification for Electric-Resistance-Welded Carbon and Alloy Steel Mechanical Tubing.
    e. ASTM A786 Standard Specification for Hot-Rolled Carbon, Low-Alloy, High-Strength Low-Alloy, and Alloy Steel Floor Plates.
    f. ASTM A1008 Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable.
    g. ASTM A1011 Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength.
2. American Welding Society (AWS):
    a. AWS D1.1 Structural Welding Code - Steel.
    b. AWS D1.3 Structural Welding Code - Sheet Steel.
3. American National Standards Institute (ANSI):
    a. ANSI A117.1 Accessible and Usable Buildings and Facilities Standards.
4. The Society for Protective Coatings (SSPC):
    a. SSPC-SP3 Power Tool Cleaning.

1.03 ACTION SUBMITTALS

A. General: Submit listed submittals in accordance with Contract Conditions and Section 01 33 00 - Submittal Procedures.

B. Product Data: Submit specified products as follows:

1. Manufacturer's product data.
2. Manufacturer's installation instructions.

C. Shop Drawings: Indicate information on shop drawings as follows:

1. Stair plans, elevations, details, methods of installation and anchoring.
    a. Show members, sizes and thickness, anchorage locations and accessory items.
    b. Furnish setting diagrams for anchorage installation as required.

c. Include calculations stamped by a structural engineer registered in the jurisdiction in which the project is located.

D. Samples: Submit as follows:

1. Two samples, minimum size 6 inches (152 mm) square, representing actual product, finish and patterns for each finished tread product specified.

1.04 INFORMATION SUBMITTALS

A. Manufacturer's Instructions: Submit manufacturer's storage and installation instructions.

B. Source Quality Control: Submit documentation verifying that components and materials specified in this Section are from single manufacturer.

C. Qualification Statements:

1. Submit certificate verification that manufacturer is American Institute of Steel Construction (AISC) Certified for Standard Steel Building Structures.

2. Submit letter of verification for Installer's Qualifications.

1.05 QUALITY ASSURANCE

A. Qualifications:

1. Manufacturer:

a. American Institute of Steel Construction (AISC) Certified firm having 10 years experience manufacturing components similar to or exceeding requirements specified in scope of project.

b. Having sufficient capacity to produce and deliver required materials without causing delay in work.

2. Installer: Acceptable to manufacturer.

1.06 DELIVERY, STORAGE & HANDLING

A. Delivery and Acceptance Requirements:

1. Deliver materials in manufacturer's original packaging with identification labels intact and in sizes to suit project.

B. Storage and Handling Requirements:

1. Store materials protected from exposure to harmful weather conditions and at temperatures recommended by manufacturer.

C. Packaging Waste Management:

1. Remove packaging materials from site and dispose of at appropriate recycling facilities.

2. Collect and separate for disposal paper, plastic, polystyrene, corrugated cardboard, packaging material in appropriate onsite bins for recycling.

3. Fold metal and plastic banding; flatten and place in designated area for recycling.

4. Remove:

a. Pallets from site and return to supplier or manufacturer.

PART 2 PRODUCTS

2.01 METAL STAIRS

A. Manufacturer: Sharon Stairs or approved equal.

1. Contact: 1481 Exeter Road, Akron, OH 44306; Telephone: (330) 777-5377; Fax: (330) 777-5350; E-mail: sales@sharonstair.com; website: www.sharonstair.com.

2. Single Source Responsibility: Provide components and materials specified in this section from a single American Institute of Steel Construction (AISC) Certified manufacturer.

3. Substitution Limitations:

a. Substitutions: Customized steel stairs will be considered.

B. Design Criteria:

1. Structural Performance of Stairs: Stairs shall withstand the following structural loads without exceeding the allowable design working stress of materials, including anchors and connections. Apply each load to produce the maximum stress in each component:
    a. Treads and Platforms of Metal Stairs: Capable of withstanding a uniform load of 100 psf (4.8 kN/m^2) and concentrated load of 300 lbf (1.33 kN) applied on an area of 4 square inches (2581 square mm). Concentrated and uniform loads need not be assumed to act concurrently.
    b. Stair Framing: Capable of withstanding stresses resulting from loads specified, in addition to stresses resulting from railing system loads.
    c. Limit Deflection of Treads, Platforms and Framing Members: To L/240.
2. Structural Performance of Handrails and Railings: Handrails and railings shall withstand the following structural loads without exceeding the allowable design working stress of materials, including handrails, railings, anchors and connections.
    a. Top Rail of Guardrail: Capable of withstanding a concentrated load of 200 lbf (0.89 kN) applied in any direction and a uniform load of 50 psf (2.39 kN/m^2) applied in any direction. Concentrated and uniform loads need not be assumed to act concurrently.

C. Standard Stair and Rail System:

1. Manufacturer's standard prefabricated, pre-engineered straight run stair and landing system, consisting of hot rolled steel sheet stringers, risers, treads, landings, fasteners/supports and railings.
    a. Stringers:
        1) Steel plate or channel with side mounted prefabricated railings.
        2) Minimum thickness or gage as determined by structural design calculations, structural grade steel plate or channel.
2. Risers: Closed riser, minimum 14 gage (1.9 mm) hot rolled mild steel sheet, sloped maximum 1 1/2 inches (38.1 mm) and conforming to Americans with Disabilities Act (ADA) nosing requirements.
3. Treads: Manufacturer's standard concrete pan system, field poured. Tread pans to be minimum of 14 gage (1.9 mm), or as determined by design calculations. Pan depth 1 1/2 inches (38.1 mm). Exposed welds from the bottom side of flight assemblies will not be allowed. All welds to be from topside of tread pans as recommended by manufacturer.
4. Mid Landings: Minimum of 12 gage (2.7 mm) hot-rolled mild steel sheets, formed for a minimum 2 1/2 inches (64 mm) concrete fill, with 11 gage channel supports and bracing welded to perimeter frame at 12 inches (305 mm) on center.
5. Fasteners and Supports: Sized by the manufacturer to meet structural design criteria. If hanger rod connections are applicable to any of the landing connections, they shall be a minimum of 5/8 inch (15.9 mm) diameter steel rod, with actual size based on stair load.
6. Manufacturer's standard welded steel tube railing system complying with the following requirements:
    a. Rails: 1 1/2 inches (38.1 mm) diameter x 13 gage (2.3 mm) minimum round steel tube, continuous multi-strand type, equally spaced with not more than 3 15/16 inches (100 mm) clearance between strands and with a minimum extension per code at top and bottom risers. Wrap rail continuously past space between flights to form guardrail as required by building code. Terminate rail ends with radiused returns, newel posts or safety terminations approved by local code. Provide not less than 1 1/2 inches (38.1 mm) clearing between rail and wall.
    b. Rail Posts: 1 1/2 inches (38.1 mm) square x 11 gage (3 mm) tubing. Rail posts to fasten to side of plate stringers per manufacturer's shop drawings. Manufacturer to

pre-weld erection aid to rail post for proper height to aid stair erector. Erection aid (setting block) to be removed and weld-ground smooth after installation.

c. Fabrication:

1) Use preformed or prefabricated bends.

2) Butt weld tee and cross intersections in tubing. Cope and weld intersections in pipe. Miter elbows.

3) Mechanically fasten internal sleeves and fittings.

4) Provide minimum 12 gage (2.7 mm) welded steel plate closures or hemispherical closure fittings on all exposed rail ends.

D. Custom Stair and Rail System:

1. Support System: Provide landing support with manufacturer's standard system. Comply with details indicated on Drawings.

a. Hanger rod landing supports.

b. Tube strut landing supports.

c. Shelf angle landing supports.

d. Knockdown (KD) landing supports.

2. Rail System: Provide rail system. Comply with details indicated on Drawings.

a. Standard 34 inch (864 mm) height handrail system with 42 inch (1067 mm) guardrails at landings and openings.

1) Rail Type: Full mesh panel rail, Picket style rail, 5-Line sweep rail, or Perforated panel rail.

b. Standard 36 inch (914 mm) height handrail system with 42 inch (1067 mm) guardrails at landings and openings.

1) Rail Type: Full mesh panel rail, Picket style rail, 6-Line sweep rail, or Perforated panel rail.

c. Standard 42 inch (1067 mm) height guard rail system with 34 inch (864 mm) ADA Grab and with 42 inch (1067 mm) guardrails at landings and openings.

1) Rail Type: Full mesh panel guard rail with hand rail, Picket style guard rail with handrail, 7-Line sweep guard rail with handrail, or Perforated panel guard rail with handrail.

3. Wall Handrails: Match stair handrails. Provide manufacturer's standard pressed steel wall brackets with anchors suitable for supporting construction.

4. Tread Construction: Comply with details indicated on Drawings.

a. Tread with factory applied abrasive filled epoxy, 3/8 inch (9.5 mm) thick, 8000 psi (55,158 kPa) compressive strength.

1) Acceptable Material: Tuff-Tread as manufactured by Sharon Stairs.

b. Factory applied slip- and wear-resistant abrasive epoxy coating applied directly to flat steel treads.

1) Acceptable Material: Tuff-Coat as manufactured by Sharon Stairs.

c. Slip-resistant checkered floor plate treads.

1) Acceptable Material: Checkered Floor Plate Treads as manufactured by Sharon Stairs.

d. Tread with 1 1/2 inch (38.1 mm) thick, 5000 psi (34,474 kPa) compressive strength, natural concrete color with broom finish.

1) Acceptable Material: Drop-In Precast Treads as manufactured by Sharon Stairs.

e. 1 1/2 inch (38.1 mm) pan type treads for field-poured concrete.

1) Acceptable Material: Field-Poured Concrete Treads as manufactured by Sharon Stairs.

5. Barrier Gates: Manufacturer's standard swing gate assembly with steel spring hinges and rubber bumper between barrier/gate assembly and rail post.

E. Materials:

1. Steel Shapes and Plates: To ASTM A36.
2. Steel Pipe: To ASTM A53 Type E or S, Grade B.
3. Steel Tubing:
   a. Structural Use: To ASTM A500, Grade B or C.
   b. Non-Structural Use: To ASTM A513, hot rolled or coiled rolled (mill option).
4. Steel Sheet:
   a. Structural Use: To ASTM A1011 (hot rolled).
   b. Non-Structural Use: To ASTM A786, ASTM A1008.
5. Fasteners: As recommended by manufacturer.
6. Welding Rods: In accordance with AWS code and AWS filler metal specifications for material being welded.
7. Primer: HAPS-free, solvent-based, rust inhibitive primer containing less than 3.5 lb/gal (1.6 kg/L) Volatile Organic Compounds (VOC) and compatible with conventional alkyds topcoats.

F. Fabrication:

1. Use same material and finish as parts being joined. Use stainless steel between dissimilar metals and non-corrosive fasteners at exterior connections or joints.
2. Provide fasteners of sufficient strength to support connected members and loads, and to develop full strength of parts fastened or connected.
3. Construct stairs and rails with all components necessary for support and anchorage, and for a complete installation.

G. Finishes

1. Rails and Stair Components: Completely remove oil, grease, dirt, mill scale, rust, corrosion products, oxides, paint or other foreign matter from steel surface in accordance with SSPC SP3.
2. Shop Primer: Immediately after fabrication and cleaning, spray apply primer to dry film thickness recommended by the primer manufacturer, but not less than 2.0 mil thickness. Apply one coat High Solids Red Oxide Anticorrosive primer meeting SSPC-15 Paint.
3. AESS: see architectural drawings for required designated steel in stairs that are to follow AESS standards.

2.02 ACCESSORIES

A. Anchor bolts, clip angles, hanger rods, hardware and incidental materials required for complete installation, as recommended by the manufacturer.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verification of Conditions: Verify that conditions of substrates previously installed under other sections or contracts are acceptable for product installation in accordance with manufacturer's instructions prior to metal stair and railing installation.

1. Inform Architect of unacceptable conditions immediately upon discovery.

2. Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval from Architect.

3.02 PREPARATION

A. Ensure structure or substrate is adequate to support metal stairs and railings.

3.03 INSTALLATION

A. Coordinate metal stairs and railings work with work of other trades for proper time and sequence to avoid construction delays.

B. Install stairs, landings and handrails in accordance with manufacturer's instructions. Install square, plumb, straight and true to line and level, with neatly fitted joints and intersections.

1. Do not cut or alter structural components without written authorization.
2. Field welding and joining shall conform to AWS D1.1 and AWS D1.3.
3. Grind all exposed welds smooth and touch-up shop-primed areas with same primer as used by manufacturer.

3.04 CLEANING

A. Upon completion, remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 23 - Final Cleaning.

B. Waste Management:

1. Collect recyclable waste and dispose of or recycle field generated construction waste created during demolition, construction or final cleaning.
2. Remove recycling containers and bins from site.

END OF SECTION

SECTION 05 5213 - PIPE AND TUBE RAILINGS

PART 2 PRODUCTS

1.01 RAILINGS - GENERAL REQUIREMENTS

A. Design, fabricate, and test railing assemblies in accordance with the most stringent requirements of ASTM E985 and applicable local code.

B. Allow for expansion and contraction of members and building movement without damage to connections or members.

C. Dimensions: See drawings for configurations and heights.
   1. Top Rails and Wall Rails: 1-1/2 inches diameter, round.
   2. Intermediate Rails: 1-1/2 inches diameter, round.
   3. Posts: 1-1/2 inches diameter, round.

D. Provide anchors and other components as required to attach to structure, made of same materials as railing components unless otherwise indicated; where exposed fasteners are unavoidable provide flush countersunk fasteners.

E. Provide slip-on non-weld mechanical fittings to join lengths, seal open ends, and conceal exposed mounting bolts and nuts, including but not limited to elbows, T-shapes, splice connectors, flanges, escutcheons, and wall brackets.

1.02 STEEL RAILING SYSTEM

A. Steel Pipe: ASTM A53/A53M, Grade B Schedule 40, black finish.

B. Welding Fittings: Factory- or shop-welded from matching pipe or tube; seams continuously welded; joints and seams ground smooth.

C. Exposed Fasteners: No exposed bolts or screws.

D. Straight Splice Connectors: Steel concealed spigots.

E. Shop and Touch-Up Primer: SSPC-Paint 15, complying with VOC limitations of authorities having jurisdiction.

1.03 FABRICATION

A. Accurately form components to suit specific project conditions and for proper connection to building structure.

B. Fit and shop assemble components in largest practical sizes for delivery to site.

C. Fabricate components with joints tightly fitted and secured. Provide spigots and sleeves to accommodate site assembly and installation.

D. Welded Joints:

1. Exterior Components: Continuously seal joined pieces by intermittent welds and plastic filler. Drill condensate drainage holes at bottom of members at locations that will not encourage water intrusion.
2. Interior Components: Continuously seal joined pieces by intermittent welds and plastic filler.
3. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius.

END OF SECTION

SECTION 06 1000 - ROUGH CARPENTRY

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Rough opening framing for doors, windows, and roof openings.

B. Roof-mounted curbs.

C. Roofing nailers.

D. Preservative treated wood materials.

E. Fire retardant treated wood materials.

F. Miscellaneous framing and sheathing.

G. Communications and electrical room mounting boards.

H. Concealed wood blocking, nailers, and supports.

I. Miscellaneous wood nailers, furring, and grounds.

1.02 RELATED REQUIREMENTS

A. Section 07 2100 - Thermal Insulation: Exterior building sheating.

B. Section 09 2116 - Gypsum Board Assemblies: Gypsum-based sheathing.

1.03 REFERENCE STANDARDS

A. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2016a.

B. ASTM C1177/C1177M - Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing; 2013.

C. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2016.

D. AWPA U1 - Use Category System: User Specification for Treated Wood; 2012.

E. PS 1 - Structural Plywood; 2009.

F. PS 20 - American Softwood Lumber Standard; 2015.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide technical data on wood preservative materials and application instructions.

1.05 DELIVERY, STORAGE, AND HANDLING

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

B. Fire Retardant Treated Wood: Prevent exposure to precipitation during shipping, storage, or installation.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

A. Dimension Lumber: Comply with PS 20 and requirements of specified grading agencies.
   1. Species: Douglas Fir, unless otherwise indicated.
   2. Grading Agency: Any grading agency whose rules are approved by the Board of Review, American Lumber Standard Committee (www.alsc.org) and who provides grading service for the species and grade specified; provide lumber stamped with grade mark unless otherwise indicated.

B. Lumber fabricated from old growth timber is not permitted.

2.02 DIMENSION LUMBER FOR CONCEALED APPLICATIONS

A. Sizes: Nominal sizes as indicated on drawings, S4S.

B. Moisture Content: S-dry or MC19.

C. Stud Framing (2 by 2 through 2 by 6):
   1. Species: Douglas Fir.
   2. Grade: No. 2.

D. Joist, Rafter, and Small Beam Framing (2 by 6 through 4 by 16):
   1. Machine stress-rated (MSR) as follows:
      a. Fb-single (minimum extreme fiber stress in bending): 1350 psi.
      b. E (minimum modulus of elasticity): 1,300,000 psi.
   2. Species: Douglas Fir.

E. Miscellaneous Framing, Blocking, Nailers, Grounds, and Furring:
   1. Lumber: S4S, No. 2 or Standard Grade.
   2. Boards: Standard or No. 3.

2.03 CONSTRUCTION PANELS

A. Communications and Electrical Room Mounting Boards: PS 1 A-D plywood, or medium density fiberboard; 3/4 inch thick; flame spread index of 25 or less, smoke developed index of 450 or less, when tested in accordance with ASTM E84.

2.04 ACCESSORIES

A. Fasteners and Anchors:
   1. Metal and Finish: Hot-dipped galvanized steel complying with ASTM A153/A153M for high humidity and preservative-treated wood locations, unfinished steel elsewhere.
   2. Drywall Screws: Bugle head, hardened steel, power driven type, length three times thickness of sheathing.
   3. Anchors: Toggle bolt type for anchorage to hollow masonry.

B. Sill Gasket on Top of Foundation Wall: 1/4 inch thick, plate width, closed cell plastic foam from continuous rolls.

C. Sill Flashing: As specified in Section 07 6200.

D. Subfloor Adhesives: Waterproof, air cure type, cartridge dispensed.

2.05 FACTORY WOOD TREATMENT

A. Treated Lumber and Plywood: Comply with requirements of AWPA U1 - Use Category System for wood treatments determined by use categories, expected service conditions, and specific applications.
   1. Fire-Retardant Treated Wood: Mark each piece of wood with producer's stamp indicating compliance with specified requirements.
   2. Preservative-Treated Wood: Provide lumber and plywood marked or stamped by an ALSC-accredited testing agency, certifying level and type of treatment in accordance with AWPA standards.

B. Fire Retardant Treatment:
   1. Interior Type A: AWPA U1, Use Category UCFA, Commodity Specification H, low temperature (low hygroscopic) type, chemically treated and pressure impregnated; capable of providing a maximum flame spread index of 25 when tested in accordance with ASTM E84, with no evidence of significant combustion when test is extended for an additional 20 minutes.
      a. Kiln dry wood after treatment to a maximum moisture content of 19 percent for lumber and 15 percent for plywood.
      b. Treat rough carpentry items as indicated .
      c. Do not use treated wood in applications exposed to weather or where the wood may become wet.

C. Preservative Treatment:
   1. Preservative Pressure Treatment of Lumber Above Grade: AWPA U1, Use Category UC3B, Commodity Specification A using waterborne preservative.
      a. Kiln dry lumber after treatment to maximum moisture content of 19 percent.
      b. Treat lumber exposed to weather.

PART 3 EXECUTION

3.01 PREPARATION

A. Install sill gasket under sill plate of framed walls bearing on foundations; puncture gasket cleanly to fit tightly around protruding anchor bolts.

3.02 INSTALLATION - GENERAL

A. Select material sizes to minimize waste.

B. Reuse scrap to the greatest extent possible; clearly separate scrap for use on site as accessory components, including: shims, bracing, and blocking.

C. Where treated wood is used on interior, provide temporary ventilation during and immediately after installation sufficient to remove indoor air contaminants.

3.03 BLOCKING, NAILERS, AND SUPPORTS

A. Provide framing and blocking members as indicated or as required to support finishes, fixtures, specialty items, and trim.

B. In framed assemblies that have concealed spaces, provide solid wood fireblocking as required by applicable local code, to close concealed draft openings between floors and between top story and roof/attic space; other material acceptable to code authorities may be used in lieu of solid wood blocking.

C. In metal stud walls, provide continuous blocking around door and window openings for anchorage of frames, securely attached to stud framing.

D. In walls, provide blocking attached to studs as backing and support for wall-mounted items, unless other method of support is explicitly indicated.

E. Where ceiling-mounting is indicated, provide blocking and supplementary supports above ceiling, unless other method of support is explicitly indicated.

F. Provide the following specific non-structural framing and blocking:

G. Items that shall be provided with non-structural framing include, but are not limited to the following:
   1. Cabinets and shelf supports.
   2. Wall brackets.
   3. Handrails.
   4. Grab bars.
   5. Towel and bath accessories.
   6. Wall-mounted door stops.
   7. Wall paneling and trim.
   8. Joints of rigid wall coverings that occur between studs.
   9. Wall-mounted dental equipment.
   10. Televisions..

3.04 ROOF-RELATED CARPENTRY

A. Coordinate installation of roofing carpentry with deck construction, framing of roof openings, and roofing assembly installation.

B. Provide wood curb at all roof openings except where specifically indicated otherwise. Form corners by alternating lapping side members.

3.05 INSTALLATION OF CONSTRUCTION PANELS

A. Subflooring: Glue and nail to framing; staples are not permitted.

B. Roof Sheathing: Secure panels with long dimension perpendicular to framing members, with ends staggered and over firm bearing.
   1. Nail panels to framing; staples are not permitted.

C. Wall Sheathing: Secure with long dimension perpendicular to wall studs, with ends over firm bearing and staggered, using nails, screws, or staples.

D. Communications and Electrical Room Mounting Boards: Secure with screws to studs with edges over firm bearing; space fasteners at maximum 24 inches on center on all edges and into studs in field of board.
   1. At fire-rated walls, install board over wall board indicated as part of the fire-rated assembly.
   2. Where boards are indicated as full floor-to-ceiling height, install with long edge of board parallel to studs.
   3. Install adjacent boards without gaps.

3.06 CLEANING

A. Waste Disposal: Comply with the requirements of Section 01 7419 - Construction Waste Management and Disposal.
   1. Comply with applicable regulations.
   2. Do not burn scrap on project site.
   3. Do not burn scraps that have been pressure treated.
   4. Do not send materials treated with pentachlorophenol, CCA, or ACA to co-generation facilities or “waste-to-energy” facilities.

B. Do not leave any wood, shavings, sawdust, etc. on the ground or buried in fill.

C. Prevent sawdust and wood shavings from entering the storm drainage system.

END OF SECTION

SECTION 06 2000 - FINISH CARPENTRY

PART 1 GENERAL

1.01 RELATED REQUIREMENTS

A. Section 06 1000 - Rough Carpentry: Support framing, grounds, and concealed blocking.

B. Section 06 4100 - Architectural Wood Casework: Shop fabricated custom cabinet work.

1.02 REFERENCE STANDARDS

A. AWI (QCP) - Quality Certification Program; current edition at www.awiqcp.org.

B. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards; 2014.

C. AWMAC/WI (NAAWS) - North American Architectural Woodwork Standards, U.S. Version 3.0; 2016.

D. BHMA A156.9 - American National Standard for Cabinet Hardware; 2015.

E. HPVA HP-1 - American National Standard for Hardwood and Decorative Plywood; 2016.

F. PS 1 - Structural Plywood; 2009.

1.03 ADMINISTRATIVE REQUIREMENTS

A. Coordinate the work with plumbing rough-in, electrical rough-in, and installation of associated and adjacent components.

B. Sequence installation to ensure utility connections are achieved in an orderly and expeditious manner.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.

B. Product Data:
   1. Provide data on fire retardant treatment materials and application instructions.
   2. Provide instructions for attachment hardware and finish hardware.

C. Shop Drawings: Indicate materials, component profiles, fastening methods, jointing details, and accessories.
   1. Scale of Drawings: 1-1/2 inch to 1 foot, minimum.

D. Samples: Submit two samples of wood trim 9 inch long.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Protect work from moisture damage.

PART 2 PRODUCTS

2.01 FINISH CARPENTRY ITEMS

A. Surface Burning Characteristics: Provide materials having fire and smoke properties as required by applicable code.

B. Interior Woodwork Items:
   1. Moldings, Bases, Casings, and Miscellaneous Trim: Maple; prepare for clear transparent finish.
   2. Loose Shelving: Grade A Faced birch or maple plywood; prepare for clear transparent finish.

2.02 WOOD-BASED COMPONENTS

A. Wood fabricated from old growth timber is not permitted.

2.03 SHEET MATERIALS

A. Softwood Plywood, Not Exposed to View: Any face species, medium density fiberboard core; PS 1 Grade A-B, glue type as recommended for application.

B. Hardwood Plywood: Face species as indicated, plain sawn, book matched, medium density fiberboard core; HPVA HP-1, Front Face Grade AA, Back Face Grade 1, glue type as recommended for application.

2.04 HARDWARE

A. Hardware: Comply with BHMA A156.9.

2.05 FABRICATION

A. Shop assemble work for delivery to site, permitting passage through building openings.

B. When necessary to cut and fit on site, provide materials with ample allowance for cutting. Provide trim for scribing and site cutting.

2.06 SHOP FINISHING

A. Sand work smooth and set exposed nails and screws.

B. Apply wood filler in exposed nail and screw indentations.

C. On items to receive transparent finishes, use wood filler that matches surrounding surfaces and is of type recommended for the applicable finish.

D. Finish work in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), Section 5 - Finishing for grade specified and as follows:
   1. Transparent:

a. System - 1, Lacquer, Nitrocellulose.
b. Sheen: Flat.

E. Back prime woodwork items to be field finished, prior to installation.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify adequacy of backing and support framing.

B. Verify mechanical, electrical, and building items affecting work of this section are placed and ready to receive this work.

3.02 INSTALLATION

A. Set and secure materials and components in place, plumb and level.

B. Carefully scribe work abutting other components, with maximum gaps of 1/32 inch. Do not use additional overlay trim to conceal larger gaps.

C. Install prefinished paneling with full bed contact adhesive applied to substrate.

3.03 SITE APPLIED WOOD TREATMENT

A. Apply preservative treatment in accordance with manufacturer's instructions.

B. Brush apply one coats of preservative treatment on wood in contact with cementitious materials. Treat site-sawn cuts.

C. Allow preservative to dry prior to erecting members.

3.04 PREPARATION FOR SITE FINISHING

A. Set exposed fasteners. Apply wood filler in exposed fastener indentations. Sand work smooth.

B. Before installation, prime paint surfaces of items or assemblies to be in contact with cementitious materials.

3.05 TOLERANCES

A. Maximum Variation from True Position: 1/16 inch.

B. Maximum Offset from True Alignment with Abutting Materials: 1/32 inch.

END OF SECTION

SECTION 06 4100 - ARCHITECTURAL WOOD CASEWORK

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Specially fabricated cabinet units.

B. Hardware.

C. Preparation for installing utilities.

1.02 RELATED REQUIREMENTS

A. Section 06 1000 - Rough Carpentry: Support framing, grounds, and concealed blocking.

B. Section 12 3600 - Countertops.

1.03 REFERENCE STANDARDS

A. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards; 2014.

B. AWI (QCP) - Quality Certification Program; current edition at www.awiqcp.org.

C. BHMA A156.9 - American National Standard for Cabinet Hardware; 2015.

D. NEMA LD 3 - High-Pressure Decorative Laminates; 2005.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Convene a preinstallation meeting not less than one week before starting work of this section; require attendance by all affected installers.

1.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Shop Drawings: Indicate materials, component profiles, fastening methods, jointing details, and accessories.
   1. Scale of Drawings: 1-1/2 inch to 1 foot, minimum.
   2. Provide the information required by AWI/AWMAC/WI (AWS).

C. Samples: Submit actual samples of architectural cabinet construction, minimum 12 inches square, illustrating proposed cabinet, countertop, and shelf unit substrate and finish.

D. Samples: Submit actual sample items of proposed pulls, hinges, shelf standards, and locksets, demonstrating hardware design, quality, and finish.

1.06 QUALITY ASSURANCE

A. Perform work in accordance with AWI/AWMAC Architectural Woodwork Quality Standards Illustrated, Custom quality, unless other quality is indicated for specific items.

B. Perform cabinet construction in accordance with AWI/AWMAC Architectural Woodwork Quality Standards Illustrated, Custom quality, unless other quality is indicated for specific items.

C. Fabricator Qualifications: Company specializing in fabricating the products specified in this section with minimum five years of documented experience.
   1. Accredited participant in the specified certification program prior to the commencement of fabrication and throughout the duration of the project.

D. Quality Certification: Provide AWI (QCP) inspection report and quality certification of completed work.
   1. Comply with AWI (QCP) woodwork association quality certification service/program in accordance with requirements for work specified in this section: www.awiqcp.org/#sle.
      a. This AWI (QCP) project is registered as project number 17.2080.
   2. Provide labels or certificates indicating that the installed work complies with AWI/AWMAC/WI (AWS) requirements for grade or grades specified.
   3. Provide designated labels on shop drawings as required by certification program.
   4. Provide designated labels on installed products as required by certification program.
   5. Submit certifications upon completion of installation that verifies this work is in compliance with specified requirements.
   6. Arrange and pay for inspections required for certification.
   7. Replace, repair, or rework all work for which certification is refused.

1.07 MOCK-UP

A. Provide mock-up of typical base cabinet, wall cabinet, and countertop, including hardware, finishes, and plumbing accessories.

B. Locate as indicated on drawings.

C. Mock-up may remain as part of the Work.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Protect units from moisture damage.

1.09 FIELD CONDITIONS

A. During and after installation of custom cabinets, maintain temperature and humidity conditions in building spaces at same levels planned for occupancy.

PART 2 PRODUCTS

2.01 CABINETS

A. Quality Standard: Unless otherwise indicated provide products of quality specified by AWI/AWMAC/WI (AWS) for Custom Grade.

B. Plastic Laminate Faced Cabinets: Custom grade.

C. Cabinets:
   1. Cabinet Design Series: As indicated on drawings.
   2. Adjustable Shelf Loading: 50 lbs. per sq. ft.
      a. Deflection: L/144.
   3. Cabinet Style: Flush overlay.
   4. Cabinet Doors and Drawer Fronts: Flush style.
   5. Drawer Side Construction: Multiple-dovetailed.
   6. Drawer Construction Technique: Dovetail joints.

2.02 WOOD-BASED COMPONENTS

A. Wood fabricated from old growth timber is not permitted.

2.03 LAMINATE MATERIALS

A. Manufacturers:
   1. Formica Corporation: www.formica.com.
   2. Panolam Industries International, Inc; Nevamar: www.nevamar.com.
   3. Wilsonart: www.wilsonart.com.
   4. Substitutions: See Section 01 6000 - Product Requirements.

B. High Pressure Decorative Laminate (HPDL): NEMA LD 3, types as recommended for specific applications.

C. Provide specific types as indicated.
   1. Horizontal Surfaces: HGS, 0.048 inch nominal thickness, through color, colors as indicated, finish as indicated.
   2. Vertical Surfaces: VGS, 0.028 inch nominal thickness, colors as indicated, finish as indicated.
   3. Post-Formed Horizontal Surfaces: HGP, 0.039 inch nominal thickness, through color, colors as indicated, finish as indicated.
   4. Cabinet Liner: CLS, 0.020 inch nominal thickness, color as selected, finish as indicated.
   5. Laminate Backer: BKL, 0.020 inch nominal thickness, undecorated; for application to concealed backside of panels faced with high pressure decorative laminate.

2.04 ACCESSORIES

A. Adhesive: Type recommended by fabricator to suit application.

B. Plastic Edge Banding: Extruded PVC, convex shaped; smooth finish; self locking serrated tongue; of width to match component thickness.
   1. Color: As selected by Architect from manufacturer's standard range.
   2. Use at all exposed plywood edges.
   3. Use at all exposed shelf edges.

C. Fasteners: Size and type to suit application.

D. Bolts, Nuts, Washers, Lags, Pins, and Screws: Of size and type to suit application; galvanized or chrome-plated finish in concealed locations and stainless steel or chrome-plated finish in exposed locations.

E. Concealed Joint Fasteners: Threaded steel.

F. Grommets: Standard plastic, painted metal, or rubber grommets for cut-outs, in color to match adjacent surface.

2.05 HARDWARE

A. Hardware: BHMA A156.9, types as recommended by fabricator for quality grade specified.

B. Adjustable Shelf Supports: Standard side-mounted system using multiple holes for pin supports and coordinated self rests, polished chrome finish, for nominal 1 inch spacing adjustments.

C. Drawer and Door Pulls: Recessed Plastic, color to be silver or light grey.

D. Sliding Door Pulls: Circular shape for recessed installation, plastic of silver or light grey color.

E. Cabinet Locks: Keyed cylinder, two keys per lock, master keyed, steel with satin finish.

F. Catches: Magnetic.

G. Drawer Slides:
   1. Type: Full extension with overtravel.
   2. Static Load Capacity: Commercial grade.
   3. Mounting: Side mounted.
   4. Stops: Integral type.
   5. Features: Provide self closing/stay closed type.

H. Hinges: European style concealed self-closing type, steel with polished finish.

I. Sliding Door Track Assemblies: Upper and lower track of satin anodized aluminum, with matching shoe equipped with nylon rollers.

2.06 FABRICATION

A. Assembly: Shop assemble cabinets for delivery to site in units easily handled and to permit passage through building openings.

B. Edging: Fit shelves, doors, and exposed edges with specified edging. Do not use more than one piece for any single length.

C. Fitting: When necessary to cut and fit on site, provide materials with ample allowance for cutting. Provide matching trim for scribing and site cutting.

D. Plastic Laminate: Apply plastic laminate finish in full uninterrupted sheets consistent with manufactured sizes. Fit corners and joints hairline; secure with concealed fasteners. Slightly bevel arises. Locate counter butt joints minimum 2 feet from sink cut-outs.

E. Matching Wood Grain: Comply with requirements of quality standard for specified Grade and as follows:
   1. Provide center matched panels at each elevation.

F. Mechanically fasten back splash to countertops as recommended by laminate manufacturer at 16 inches on center.

G. Provide cutouts for plumbing fixtures. Verify locations of cutouts from on-site dimensions. Prime paint cut edges.

H. All edged and faces exposed to view shall be finished according to architect utilizing any of the same finishes of components provided.

I. Finished casework shall not have voids exposed. Any and all voids shall be capped off.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify adequacy of backing and support framing.

B. Verify location and sizes of utility rough-in associated with work of this section.

3.02 INSTALLATION

A. Install work in accordance with AWI/AWMAC/WI (AWS) requirements for grade indicated.

B. Set and secure custom cabinets in place, assuring that they are rigid, plumb, and level.

C. Use fixture attachments in concealed locations for wall mounted components.

D. Use concealed joint fasteners to align and secure adjoining cabinet units.

E. Carefully scribe casework abutting other components, with maximum gaps of 1/32 inch. Do not use additional overlay trim for this purpose.

F. Secure cabinets to floor using appropriate angles and anchorages.

G. Countersink anchorage devices at exposed locations. Conceal with solid wood plugs of species to match surrounding wood; finish flush with surrounding surfaces.

3.03 ADJUSTING

A. Adjust installed work.

B. Adjust moving or operating parts to function smoothly and correctly.

3.04 CLEANING

A. Clean casework, counters, shelves, hardware, fittings, and fixtures.

END OF SECTION

SECTION 07 1113 - BITUMINOUS DAMPPROOFING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Bituminous dampproofing.

B. Protection boards.

1.02 RELATED REQUIREMENTS

A. Section 07 2100 - Thermal Insulation: Rigid insulation board used as protection board.

1.03 REFERENCE STANDARDS

A. ASTM D41/D41M - Standard Specification for Asphalt Primer Used in Roofing, Dampproofing, and Waterproofing; 2011 (Reapproved 2016).

B. ASTM D1227 - Standard Specification for Emulsified Asphalt Used as a Protective Coating for Roofing; 2013.

C. ASTM D4586/D4586M - Standard Specification for Asphalt Roof Cement, Asbestos-Free; 2007 (Reapproved 2012).

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide properties of primer, bitumen, and mastics.

C. Manufacturer's Installation Instructions: Indicate special procedures and perimeter conditions requiring special attention.

1.05 QUALITY ASSURANCE

A. Installer Qualifications: Company specializing in performing the work of this section with at least three years of documented experience.

1.06 FIELD CONDITIONS

A. Maintain ambient temperatures above 40 degrees F for 24 hours before and during application until dampproofing has cured.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. BASF: Product; Sonneborn Hydrocide 600, 700, 700B.

B. Other Acceptable Bituminous Dampproofing Manufacturers:
   1. Karnak Corporation: www.karnakcorp.com.
   2. Mar-Flex Systems, Inc: www.mar-flex.com/sle.
   3. Seaboard Asphalt Products Company: www.seaboardasphalt.com.
   4. W. R. Meadows, Inc: www.wrmeadows.com/sle.
   5. Substitutions: See Section 01 6000 - Product Requirements.

2.02 BITUMINOUS DAMPPROOFING

A. Bituminous Dampproofing: Cold-applied, trowel-grade; asphalt base, volatile petroleum solvents, and other content, suitable for application by trowel on vertical and horizontal surfaces.
   1. Composition: ASTM D4586/D4586M Type I, minimum, asbestos free.
   2. VOC Content: Not more than permitted by local, State, and federal regulations.
   3. Applied Thickness: 1/16 inch, minimum, wet film.

B. Primers, Mastics, and Related Materials: Type as recommended by dampproofing manufacturer.

2.03 ACCESSORIES

A. Protection Board: Rigid insulation specified in Section 07 2100.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions are acceptable prior to starting this work.

B. Verify substrate surfaces are durable, free of matter detrimental to adhesion or application of dampproofing system.

C. Verify that items penetrating surfaces to receive dampproofing are securely installed.

3.02 PREPARATION

A. Protect adjacent surfaces not designated to receive dampproofing.

B. Clean and prepare surfaces to receive dampproofing in accordance with manufacturer's instructions.

C. Do not apply dampproofing to surfaces unacceptable to manufacturer.

D. Apply mastic to seal penetrations, small cracks, or minor honeycombs in substrate.

3.03 APPLICATION

A. Foundation Walls: Apply two coats of asphalt dampproofing.

B. Apply bitumen with mop.

C. Apply from 2 inches below finish grade elevation down to top of footings.

D. Seal items watertight with mastic, that project through dampproofing surface.

END OF SECTION

SECTION 07 2100 - THERMAL INSULATION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Board insulation and integral vapor retarder at cavity wall construction, perimeter foundation wall, underside of floor slabs, over roof deck, over roof sheathing, and exterior wall behind stucco, concrete and CMU wall finish. Exterior Wall Continous insulation is to be installed with compatable spray foam insulation as shown on drawings.

B. Batt insulation for filling perimeter window and door shim spaces and crevices in exterior wall and roof.

1.02 RELATED REQUIREMENTS

A. Section 03 3000 - Cast-in-Place Concrete: Field-applied termiticide for concrete slabs and foundations.

B. Section 09 2116 - Gypsum Board Assemblies: Acoustic insulation inside walls and partitions.

1.03 REFERENCE STANDARDS

A. ASTM C578 - Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation; 2016.

B. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing; 2012.

C. ASTM C1289 - Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board; 2016.

D. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2016.

E. ASTM E136 - Standard Test Method for Behavior of Materials in a Vertical Tube Furnace At 750 Degrees C; 2016a.

F. ASTM E2357 - Standard Test Method for Determining Air Leakage of Air Barrier Assemblies; 2011.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide data on product characteristics, performance criteria, and product limitations.

C. ABAA Field Quality Control Submittals: Submit third-party reports of testing and inspection required by ABAA QAP.

D. Manufacturer's Installation Instructions: Include information on special environmental conditions required for installation and installation techniques.

E. ABAA Manufacturer Qualification: Submit documentation of current evaluation of proposed manufacturer and materials.

F. ABAA Installer Qualification: Submit documentation of current contractor accreditation and current installer certification. Keep copies of contractor accreditation and installer certification on site during and after installation. Present on-site documentation upon request.

1.05 QUALITY ASSURANCE

A. Air Barrier Association of America (ABAA) Quality Assurance Program (QAP); www.airbarrier.org/#sle:
   1. Installer Qualification: Use accredited contractor, certified installers, evaluated materials, and third-party field quality control audit.
   2. Manufacturer Qualification: Use evaluated materials from a single manufacturer regularly engaged in air barrier material manufacture. Use secondary materials approved in writing by primary material manufacturer.
   3. Spray Polyurethane Foam (SPF) Installer Qualifications: Company specializing in performing SPF work of the type specified and with at least three years of documented experience and certified by manufacturer.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Thermal Insulation: WALL CONTINOUS INSULATION SYSTEM: **Foam on Foam System**
   1. Basis of Design: Dow THERMAX WALL SYSTEM: THERMAX XARMOR (Ci) Exterior Insulation on, LIQUIDARMOR Flashing and Sealant. STYROFOAM CM Series SPF Insulation. https://www.dupont.com/building/thermax-wall-system.html.
   2. Equivalent to Basis of design System from GAF..
   3. Equivalent to Basis of design system from RMAX.
   4. Equivalent to Basis of design system from Owens Corning.
   5. Other systems will be acceptable as long as they meet or exceed Basis of design system specifications. Written prior approvals will be required during bid phase for such systems.

B. Thermal Insulation: FOUNDATION INSULATION SYSTEM:
   1. Basis of Design: Dow STYROFOAM PERIMATE Insulation with ENERBOND Professional foam adhesive.. https://www.dupont.com/building/thermax-wall-system.html.
   2. Equivalent to Basis of design System from GAF..
   3. Equivalent to Basis of design system from RMAX.
   4. Equivalent to Basis of design system from Owens Corning.
   5. Other systems will be acceptable as long as they meet or exceed Basis of design system specifications. Written prior approvals will be required during bid phase for such systems.

C. Substitutions: See Section 01 6000 - Product Requirements.

2.02 APPLICATIONS

A. Insulation at Perimeter of Foundation: Extruded polystyrene (XPS) board.

B. Insulation Over Metal Stud Framed Walls, Continuous: Polyisocyanurate board.

C. Insulation on Inside of Concrete and Masonry Exterior Walls: Polyisocyanurate board.

2.03 FOAM BOARD INSULATION MATERIALS

A. Extruded Polystyrene (XPS) Board Insulation: Complies with ASTM C578 with either natural skin or cut cell surfaces.
   1. Flame Spread Index (FSI): Class A - 0 to 25, when tested in accordance with ASTM E84.
   2. Smoke Developed Index (SDI): 450 or less, when tested in accordance with ASTM E84.
   3. Type and Thermal Resistance, R-value: Type IV, 5.0 (0.88) per 1 inch thickness at 75 degrees F mean temperature.

B. Polyisocyanurate (ISO) Board Insulation: Rigid cellular foam, complying with ASTM C1289.
   1. Classifications:
      a. Type I: Faced with aluminum foil on both major surfaces of the core foam.
         1) Class 1 - Non-reinforced core foam.
         2) Compressive Strength: 16 psi, minimum.
         3) Thermal Resistance, R-value: At 1-1/2 inch thick; 9.0 at 75 degrees F.
   2. Board Size: 48 inch by 96 inch.
   3. Board Thickness: 1.5 inch.

2.04 BATT INSULATION MATERIALS

A. Glass Fiber Batt Insulation: Flexible preformed batt or blanket, complying with ASTM C665; friction fit.
   1. Combustibility: Non-combustible, when tested in accordance with ASTM E136, except for facing, if any.

B. Mineral Fiber Batt Insulation: Flexible or semi-rigid preformed batt or blanket, complying with ASTM C665; friction fit; unfaced flame spread index of 0 (zero) when tested in accordance with ASTM E84.
   1. Smoke Developed Index: 0 (zero), when tested in accordance with ASTM E84.

2.05 ACCESSORIES

A. Foam Sealant Penetration Filler: Provide single component spray polyurethane foam (SPF) for sealing wall penetrations through board insulation.
   1. Products: GREAT STUFF PRO Gaps and Cracks single component polyurethane low-pressure sealant or GREAT STUFF PRO Window and Door single component polyurethane low-pressure foam sealant as manufactured by Dow Chemical Company.

B. Flashing and Sealant: Provide for sealing joints, seams and veneer tie penetrations through board insulation.

1. Spray applied elastomeric liquid flashing and sealant, grey-blue color.
   a. Product: LIQUIDARMOR CM as manufactured by Dow Chemical Company.
2. Joint Flashing Tape: Provide for sealing joints, seams and veneer tie penetrations through board insulation as recommended by manufacturer.

END OF SECTION

SECTION 07 2500 - WEATHER BARRIERS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Water-Resistive Barrier: Under exterior wall cladding, over sheathing or other substrate; not air tight or vapor retardant.

B. Vapor Retarders: Materials to make exterior walls, joints between exterior walls and roof, and joints around frames of openings in exterior walls water vapor resistant and air tight.

C. Air Barriers: Materials that form a system to stop passage of air through exterior walls, joints between exterior walls and roof, and joints around frames of openings in exterior walls.

1.02 RELATED REQUIREMENTS

A. Section 03 3000 - Cast-in-Place Concrete: Vapor retarder under concrete slabs on grade.

B. Section 06 1000 - Rough Carpentry: Water-resistive barrier under exterior cladding.

C. Section 07 2100 - Thermal Insulation: Vapor retarder installed in conjunction with batt insulation.

D. Section 07 2400 - Exterior Insulation and Finish Systems: Water-resistive barrier under exterior insulation.

E. Section 09 2116 - Gypsum Board Assemblies: Water-resistive barrier under exterior cladding.

1.03 DEFINITIONS

A. Weather Barrier: Assemblies that form either water-resistive barriers, air barriers, or vapor retarders.

B. Air Barrier: Air tight barrier made of material that is relatively air impermeable but water vapor permeable, both to the degree specified, with sealed seams and with sealed joints to adjacent surfaces. Note: For the purposes of this specification, vapor impermeable air barriers are classified as vapor retarders.

C. Vapor Retarder: Air tight barrier made of material that is relatively water vapor impermeable, to the degree specified, with sealed seams and with sealed joints to adjacent surfaces.
   1. Water Vapor Permeance: For purposes of conversion, 57.2 ng/(Pa s sq m) = 1 perm.

D. Water-Resistive Barrier: Water-shedding barrier made of material that is moisture resistant, to the degree specified, intended to be installed to shed water without sealed seams.

1.04 REFERENCE STANDARDS

A. 40 CFR 59, Subpart D - National Volatile Organic Compound Emission Standards for Architectural Coatings; U.S. Environmental Protection Agency; current edition.

B. AATCC Test Method 127 - Water Resistance: Hydrostatic Pressure Test; 2014.

C. ASTM D1970/D1970M - Standard Specification for Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection; 2015a.

D. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials; 2016.

E. ASTM E2178 - Standard Test Method for Air Permeance of Building Materials; 2013.

F. ICC-ES AC38 - Acceptance Criteria for Water-Resistive Barriers; ICC Evaluation Service, Inc; 2013.

G. ICC-ES AC148 - Acceptance Criteria for Flexible Flashing Materials; ICC Evaluation Service, Inc; 2011.

H. ICC-ES AC212 - Acceptance Criteria for Water-Resistive Coatings Used as Water-Resistive Barriers over Exterior Sheathing; ICC Evaluation Service, Inc; 2015.

1.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide data on material characteristics.

C. Shop Drawings: Provide drawings of special joint conditions.

1.06 MOCK-UP

A. Install air barrier and water-resistive barrier materials in mock-up specified in Section 072400.

1.07 FIELD CONDITIONS

A. Maintain temperature and humidity recommended by the materials manufacturers before, during and after installation.

PART 2 PRODUCTS

2.01 WEATHER BARRIER ASSEMBLIES

A. Water-Resistive Barrier: Provide on exterior walls under exterior cladding.
   1. Under Portland cement stucco, use two separate layers of building paper.

B. Air Barrier:
   1. On outside surface of sheathing of exterior walls use air barrier coating.

C. Exterior Vapor Retarder:
   1. On outside surface of sheathing use vapor retarder coating.

2.02 WATER-RESISTIVE BARRIER MATERIALS (NEITHER AIR BARRIER OR VAPOR RETARDER)

A. Building Paper: Asphalt-saturated Kraft building paper complying with requirements of ICC-ES AC38 Grade D.
   1. Water Penetration Resistance: Withstand a water head of 21 inches, minimum, for minimum of five hours, when tested in accordance with AATCC Test Method 127.

B. Plastic Sheet: Polymeric-based sheet complying with requirements of ICC-ES AC38 Grade D with 60-minute water-resistance; do not use polyethylene sheet.

2.03 AIR BARRIER MATERIALS (WATER VAPOR PERMEABLE AND WATER-RESISTIVE)

A. Air Barrier, Fluid Applied: Vapor permeable, elastomeric waterproofing.

2.04 VAPOR RETARDER MATERIALS (AIR BARRIER AND WATER-RESISTIVE)

A. Vapor Retarder Coating: Liquid applied, resilient, UV-resistant coating and associated joint treatment.
   1. Water Vapor Permeance: 1.0 perm, maximum, when tested in accordance with ASTM E96/E96M.
   2. VOC Content: Less than 50 g per L when tested in accordance with 40 CFR 59, Subpart D (EPA Method 24).
   3. Suitable for use on concrete, masonry, plywood and gypsum sheathing.
   4. Joint Preparation Treatment: Coating manufacturer's recommended method, either tape or reinforcing mesh saturated with coating material.
   5. Manufacturers:
      a. BASF Corporation; MasterSeal AWB 660 I: www.master-builders-solutions.basf.us/#sle.
      b. Carlisle Coatings and Waterproofing, Inc; Barriseal-R: www.carlisleccw.com/#sle.
   6. Joint Filler: As recommended by coating manufacturer and suitable to the substrate.

2.05 ACCESSORIES

A. Flexible Flashing: Sheathing fabric saturated with air barrier coating and complying with the applicable requirements of ICC-ES AC148.

B. Thinners and Cleaners: As recommended by material manufacturer.

C. Attachment Battens: Galvanized steel bars, size as required; with anchors of same material.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that surfaces and conditions are ready to accept the work of this section.

3.02 PREPARATION

A. Remove projections, protruding fasteners, and loose or foreign matter that might interfere with proper installation.

B. Clean and prime substrate surfaces to receive adhesives in accordance with manufacturer's instructions.

3.03 INSTALLATION

A. Install materials in accordance with manufacturer's instructions.

B. Water-Resistive Barriers: Install continuous barrier over surfaces indicated, with sheets lapped to shed water but with seams not sealed.

C. Air Barriers: Install continuous air tight barrier over surfaces indicated, with sealed seams and with sealed joints to adjacent surfaces.

D. Vapor Retarders: Install continuous air tight barrier over surfaces indicated, with sealed seams and with sealed joints to adjacent surfaces.

E. Mechanically Fastened Sheets - On Exterior:
   1. Install sheets shingle-fashion to shed water, with seams generally horizontal.
   2. Overlap seams as recommended by manufacturer but at least 6 inches.
   3. Overlap at outside and inside corners as recommended by manufacturer but at least 12 inches.
   4. Install water-resistive barrier over jamb flashings.
   5. Install air barrier and vapor retarder UNDER jamb flashings.
   6. Install head flashings under weather barrier.
   7. At openings to be filled with frames having nailing flanges, wrap excess sheet into opening; at head, seal sheet over flange and flashing.

F. Coatings:
   1. Prepare substrate in manner recommended by coating manufacturer; treat joints in substrate and between dissimilar materials as recommended by manufacturer.
   2. Use flashing to seal to adjacent construction and to bridge joints.

G. Openings and Penetrations in Exterior Weather Barriers:
   1. Install flashing over sills, covering entire sill frame member, extending at least 5 inches onto weather barrier and at least 6 inches up jambs; mechanically fasten stretched edges.
   2. At openings to be filled with frames having nailing flanges, seal head and jamb flanges using a continuous bead of sealant compressed by flange and cover flanges with sealing tape at least 4 inches wide; do not seal sill flange.
   3. At openings to be filled with non-flanged frames, seal weather barrier to each side of opening framing, using flashing at least 9 inches wide, covering entire depth of framing.
   4. At head of openings, install flashing under weather barrier extending at least 2 inches beyond face of jambs; seal weather barrier to flashing.
   5. At interior face of openings, seal gap between window/door frame and rough framing, using joint sealant over backer rod.

6. Service and Other Penetrations: Form flashing around penetrating item and seal to weather barrier surface.

3.04 FIELD QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements, for additional requirements.

B. Coordination of ABAA Tests and Inspections:
   1. Provide testing and inspection required by ABAA QAP.
   2. Notify ABAA in writing of schedule for air barrier work, and allow adequate time for testing and inspection.
   3. Cooperate with ABAA testing agency.
   4. Allow access to air barrier work areas and staging.
   5. Do not cover air barrier work until tested, inspected, and accepted.

3.05 PROTECTION

A. Do not leave materials exposed to weather longer than recommended by manufacturer.

B. Do not leave paper- or felt-based barriers exposed to weather for longer than one week.

END OF SECTION

SECTION 07 2600

UNDER-SLAB VAPOR RETARDER FOR CONCRETE SLABS-ON-GRADE

PART 1 GENERAL

1.01 SUMMARY

A. Products Supplied Under This Section

1. Vapor Retarder, seam tape, mastic, pipe boots for installation under concrete slabs.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Cast-in-place Concrete - Section 03 30 00

B. Concrete Forming and Accessories - Section 03 20 00

C. Earthwork for Building Construction - Section 31 23 11

1.03 REFERENCES

A. American Society for Testing and Materials (ASTM)

1.	ASTM E 96/ E96M-10	Standard Test Methods for Water Vapor Transmission of Materials
2.	ASTM E 154-08a	Standard Test Methods for Water Vapor Retarders Used in Contact with Earth Under Concrete Slabs
3.	ASTM E 1643-11	Standard Practice for Selection, Design, Installation and Inspection of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs
4.	ASTM E 1745-11	Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill Under Concrete Slabs

B. American Concrete Institute (ACI)

1. ACI 302.2R-06, Guide for Concrete Slabs that Receive Moisture-Sensitive Flooring Materials.

1.04 SUBMITTALS

A. Quality Control / Assurance

1. Comply with Section 01 33 00 – Submittal Procedures.
2. Independent laboratory test results showing compliance with ASTM & ACI Standards.
3. Manufacturer’s samples, literature
4. Manufacturer’s installation instructions for placement, seaming and pipe boot installation

B. Delivery, Storage, and Handling

1. Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly identifying product name and manufacturer.
2. Store materials in a clean dry area in accordance with manufacturer's instructions.
3. Stack membrane on smooth ground or wood platform to eliminate warping.
4. Protect materials during handling and application to prevent damage or contamination.
5. Ensure membrane is stamped with manufacturer’s name, product name and membrane thickness at intervals of no more than 85” (220 cm).

C. Environmental requirements

1. Product not intended for uses subject to abuse or permanent exposure to the elements.
2. Do not apply on frozen ground.

PART 2 PRODUCTS

2.01 MATERIALS

A. Vapor Retarder (Performance-Based Specifications)

1. Vapor Retarder must have the following qualities at minimum and meet floor finish manufacturer's warranty requirements.
    a. Water Vapor Retarder ASTM E1745: Meets or exceeds Class A
    b. Maximum Permeance ASTM E96: 0.01 Perms or as required to meet Flooring Manufacturer's Warranties.
    c. Tensile Strength ASTM E154, Section 9: not less than 45 LBS. Force/Inch
    d. Puncture Resistance ASTM D1709, Method B.
    e. Thickness of Retarder (plastic) ACI 302.1R-96: Not less than 15 mils
    f. Material: Virgin Polyethylene or Polyolefin
2. Vapor Retarder Products, may be by one of the following manufacturers or an approved equal, as long as the requirements above are met.
    a. Epro, http://eproserv.com
    b. Fortifiber, http://www.fortifiber.com
    c. Stego Industries, http://www.stegoindustries.com
    d. W.R. Meadows, http://www.wrmeadows.com
    e. Raven Industries, http://www.vaporblock.com
    f. Reef Industries, http://www.reefindustries.com
    g. Insulation Solutions, http://www.insulationsolution.com

2.02 ACCESSORIES

A. Seam Tape
    1. Tape must have the following qualities:
        a. Water Vapor Transmission Rate ASTM E 96 0.3 perms or lower

B. Vapor Proofing Mastic
    1. Mastic must have the following qualities:
        a. Water Vapor Transmission Rate ASTM E 96 0.3 perms or lower

C. Pipe Boots
    1. Construct pipe boots from vapor Retarder material, pressure sensitive tape and/or mastic per manufacturer's instructions.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine surfaces to receive membrane. Ensure compaction requirements have been completed and geotechnical firm has confirmed compaction requirements have been met. Notify Architect if surfaces are not acceptable. Do not begin surface preparation or application until unacceptable conditions have been corrected.

3.02 SURFACE PREPARATION

A. Prepare surfaces in accordance with manufacturers instructions.

3.03 INSTALLATION

A. Install Vapor Retarder:
    1. Installation shall be in accordance with manufacturer's instructions and ASTM E 1643.
        a. Unroll Vapor Retarder with the longest dimension parallel with the direction of the pour.
        b. Lap Vapor Retarder over footings and seal to foundation walls.
        c. Overlap joints 6 inches and seal with manufacturer's tape.
        d. Seal all penetrations (including pipes) per manufacturer's instructions.
        e. No penetration of the Vapor Retarder is allowed except for reinforcing steel and permanent utilities.

f. Repair damaged areas by cutting patches of Vapor Retarder, overlapping damaged area 6 inches and taping all four sides with tape.

END OF SECTION

SECTION 07 6200 - SHEET METAL FLASHING AND TRIM

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Fabricated sheet metal items, including flashings, counterflashings, gutters, and downspouts.

B. Sealants for joints within sheet metal fabrications.

C. Precast concrete splash pads.

1.02 RELATED REQUIREMENTS

A. Section 07 7200 - Roof Accessories: Manufactured metal roof curbs.

B. Section 08 6300 - Metal-Framed Skylights: Integral metal curbs.

C. Section 23 0548 - Vibration and Seismic Controls for HVAC: Vibration isolation curbs for mechanical equipment.

1.03 REFERENCE STANDARDS

A. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix); 2013.

B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2015.

C. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2014a.

D. ASTM D4586/D4586M - Standard Specification for Asphalt Roof Cement, Asbestos-Free; 2007 (Reapproved 2012).

E. CDA A4050 - Copper in Architecture - Handbook; current edition.

F. SMACNA (ASMM) - Architectural Sheet Metal Manual; 2012.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Convene one week before starting work of this section.

1.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Shop Drawings: Indicate material profile, jointing pattern, jointing details, fastening methods, flashings, terminations, and installation details.

1.06 QUALITY ASSURANCE

A. Perform work in accordance with SMACNA (ASMM) and CDA A4050 requirements and standard details, except as otherwise indicated.

B. Fabricator and Installer Qualifications: Company specializing in sheet metal work with 5 years of documented experience.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Stack material to prevent twisting, bending, and abrasion, and to provide ventilation. Slope metal sheets to ensure drainage.

B. Prevent contact with materials that could cause discoloration or staining.

PART 2 PRODUCTS

2.01 SHEET MATERIALS

A. Galvanized Steel: ASTM A653/A653M, with G90/Z275 zinc coating; minimum 24 gage, (0.0239 inch) thick base metal.

B. Pre-Finished Galvanized Steel: ASTM A653/A653M, with G90/Z275 zinc coating; minimum 24 gage, (0.0239) inch thick base metal, shop pre-coated with PVDF coating.
   1. PVDF (Polyvinylidene Fluoride) Coating: Superior Performance Organic Finish, AAMA 2605; multiple coat, thermally cured fluoropolymer finish system.
   2. Color: As selected by Architect from manufacturer's full colors.

2.02 ACCESSORIES

A. Reglets: Recessed type, galvanized steel; face and ends covered with plastic tape.

2.03 FABRICATION

A. Form sections true to shape, accurate in size, square, and free from distortion or defects.

B. Form pieces in longest possible lengths.

C. Hem exposed edges on underside 1/2 inch; miter and seam corners.

D. Form material with flat lock seams, except where otherwise indicated; at moving joints, use sealed lapped, bayonet-type or interlocking hooked seams.

E. Fabricate corners from one piece with minimum 18 inch long legs; seam for rigidity, seal with sealant.

F. Fabricate vertical faces with bottom edge formed outward 1/4 inch and hemmed to form drip.

2.04 GUTTER AND DOWNSPOUT FABRICATION

A. Gutters: SMACNA (ASMM), Rectangular profile.

B. Downspouts: Rectangular profile.

C. Gutters and Downspouts: Size for rainfall intensity determined by a storm occurrence of 1 in 10 years in accordance with SMACNA (ASMM).

D. Accessories: Profiled to suit gutters and downspouts.
   1. Anchorage Devices: In accordance with SMACNA (ASMM) requirements.
   2. Gutter Supports: Brackets.
   3. Downspout Supports: Brackets.

E. Splash Pads: Precast concrete type, of size and profiles indicated; minimum 3000 psi at 28 days, with minimum 5 percent air entrainment.

F. Downspout Boots: Steel.

G. Seal metal joints.

2.05 ACCESSORIES

A. Fasteners: Galvanized steel, with soft neoprene washers.

B. Primer: Zinc chromate type.

C. Concealed Sealants: Non-curing butyl sealant.

D. Exposed Sealants: ASTM C920; elastomeric sealant, with minimum movement capability as recommended by manufacturer for substrates to be sealed; color to match adjacent material.

E. Plastic Cement: ASTM D4586/D4586M, Type I.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify roof openings, curbs, pipes, sleeves, ducts, and vents through roof are solidly set, reglets in place, and nailing strips located.

B. Verify roofing termination and base flashings are in place, sealed, and secure.

3.02 PREPARATION

A. Install starter and edge strips, and cleats before starting installation.

B. Back paint concealed metal surfaces with protective backing paint to a minimum dry film thickness of 15 mil.

3.03 INSTALLATION

A. Secure flashings in place using concealed fasteners, and use exposed fasteners only where permitted..

B. Apply plastic cement compound between metal flashings and felt flashings.

C. Fit flashings tight in place; make corners square, surfaces true and straight in planes, and lines accurate to profiles.

D. Seal metal joints watertight.

E. Secure gutters and downspouts in place with concealed fasteners.

F. Connect downspouts to downspout boots, and grout connection watertight.

G. Set splash pads under downspouts.

3.04 FIELD QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements, for field inspection requirements.

B. Inspection will involve surveillance of work during installation to ascertain compliance with specified requirements.

END OF SECTION

SECTION 07 8400 - FIRESTOPPING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Firestopping systems.

B. Firestopping of all joints and penetrations in fire resistance rated and smoke resistant assemblies, whether indicated on drawings or not, and other openings indicated.

1.02 RELATED REQUIREMENTS

A. Section 01 7000 - Execution and Closeout Requirements: Cutting and patching.

B. Section 09 2116 - Gypsum Board Assemblies: Gypsum wallboard fireproofing.

1.03 REFERENCE STANDARDS

A. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials; 2016a.

B. ASTM E814 - Standard Test Method for Fire Tests of Penetration Firestop Systems; 2013a.

C. ASTM E1966 - Standard Test Method for Fire Resistive Joint Systems; 2007 (Reapproved 2011).

D. ASTM E2307 - Standard Test Method for Determining Fire Resistance of Perimeter Fire Barriers Using Intermediate-Scale, Multi-story Test Apparatus; 2015a.

E. ASTM E2837 - Standard Test Method for Determining the Fire Resistance of Continuity Head-of-Wall Joint Systems Installed Between Rated Wall Assemblies and Nonrated Horizontal Assemblies; 2013.

F. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi; 2015.

G. ITS (DIR) - Directory of Listed Products; current edition.

H. FM 4991 - Approval Standard for Firestop Contractors; 2013.

I. FM (AG) - FM Approval Guide; current edition.

J. SCAQMD 1168 - South Coast Air Quality Management District Rule No.1168; current edition.

K. UL 2079 - Standard for Tests for Fire Resistance of Building Joint Systems; Current Edition, Including All Revisions.

L. UL (FRD) - Fire Resistance Directory; current edition.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Schedule of Firestopping: List each type of penetration, fire rating of the penetrated assembly, and firestopping test or design number.

C. Product Data: Provide data on product characteristics, performance ratings, and limitations.

D. Sustainable Design Submittal: Submit VOC content documentation for all non-preformed materials.

E. Manufacturer's Installation Instructions: Indicate preparation and installation instructions.

F. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

G. Installer Qualification: Submit qualification statements for installing mechanics.

1.05 QUALITY ASSURANCE

A. Fire Testing: Provide firestopping assemblies of designs that provide the scheduled fire ratings when tested in accordance with methods indicated.
   1. Listing in UL (FRD), FM (AG), or ITS (DIR) will be considered as constituting an acceptable test report.
   2. Valid evaluation report published by ICC Evaluation Service, Inc. (ICC-ES) at www.icc-es.org will be considered as constituting an acceptable test report.

B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

C. Installer Qualifications: Company specializing in performing the work of this section and:
   1. Trained by manufacturer.
   2. Approved by Factory Mutual Research Corporation under FM 4991, or meeting any two of the following requirements:
   3. Verification of minimum three years documented experience installing work of this type.
   4. Verification of at least five satisfactorily completed projects of comparable size and type.
   5. Licensed by local authorities having jurisdiction (AHJ).

1.06 FIELD CONDITIONS

A. Comply with firestopping manufacturer's recommendations for temperature and conditions during and after installation; maintain minimum temperature before, during, and for three days after installation of materials.

PART 2 PRODUCTS

2.01 MATERIALS

A. Manufacturers:
   1. A/D Fire Protection Systems Inc.: www.adfire.com.
   2. 3M Fire Protection Products: www.3m.com/firestop.

B. Firestopping Materials: Any materials meeting requirements.

C. Volatile Organic Compound (VOC) Content: Provide products having VOC content lower than that required by SCAQMD 1168.

D. Mold and Mildew Resistance: Provide firestoppping materials with mold and mildew resistance rating of zero(0) in accordance with ASTM G21.

E. Primers, Sleeves, Forms, Insulation, Packing, Stuffing, and Accessories: Provide type of materials as required for tested firestopping assembly.

F. Fire Ratings: Refer to drawings for required systems and ratings.

2.02 FIRESTOPPING ASSEMBLY REQUIREMENTS

A. Perimeter Fire Containment Firestopping: Use system that has been tested according to ASTM E2307 to have fire resistance F Rating equal to required fire rating of floor assembly.

B. Head-of-Wall Joint System Firestopping at Joints Between Fire-Rated Wall Assemblies and Non-Rated Horizontal Assemblies: Use system that has been tested according to ASTM E2837 to have fire resistance F Rating equal to required fire rating of floor or wall, whichever is greater.
   1. Movement: Provide systems that have been tested to show movement capability as indicated.

C. Floor-to-Floor, Wall-to-Wall, and Wall-to-Floor Joints, Except Perimeter, Where Both Are Fire-Rated: Use system that has been tested according to ASTM E1966 or UL 2079 to have fire resistance F Rating equal to required fire rating of the assembly in which the joint occurs.

D. Through Penetration Firestopping: Use system that has been tested according to ASTM E814 to have fire resistance F Rating equal to required fire rating of penetrated assembly.

2.03 FIRESTOPPING SYSTEMS

A. Firestopping: Any material meeting requirements.
   1. Fire Ratings: See Drawings for required systems and ratings.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify openings are ready to receive the work of this section.

3.02 PREPARATION

A. Clean substrate surfaces of dirt, dust, grease, oil, loose material, or other materials that could adversely affect bond of firestopping material.

B. Remove incompatible materials that could adversely affect bond.

3.03 INSTALLATION

A. Install materials in manner described in fire test report and in accordance with manufacturer's instructions, completely closing openings.

B. Install labeling required by code.

3.04 CLEANING

A. Clean adjacent surfaces of firestopping materials.

3.05 PROTECTION

A. Protect adjacent surfaces from damage by material installation.

END OF SECTION

SECTION 08 1113 - HOLLOW METAL DOORS AND FRAMES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Non-fire-rated hollow metal doors and frames.

B. Hollow metal frames for wood doors.

C. Fire-rated hollow metal doors and frames.

D. Thermally insulated hollow metal doors with frames.

E. Hollow metal borrowed lites glazing frames.

F. Accessories, including glazing, louvers, and matching panels.

1.02 RELATED REQUIREMENTS

A. Section 08 7100 - Door Hardware.

B. Section 08 8000 - Glazing: Glass for doors and borrowed lites.

C. Section 09 9000 - Painting: Field painting.

1.03 REFERENCE STANDARDS

A. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design; 2010.

B. ANSI/SDI A250.3 - Test Procedure and Acceptance Criteria for Factory Applied Finish Coatings for Steel Doors and Frames; 2007 (R2011).

C. ANSI/SDI A250.4 - Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors, Frames and Frame Anchors; 2011.

D. ANSI/SDI A250.8 - Specifications for Standard Steel Doors and Frames (SDI-100); 2014.

E. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2015.

F. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable; 2016.

G. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength; 2015.

H. BHMA A156.115 - American National Standard for Hardware Preparation in Steel Doors and Steel Frames; 2014.

I. ICC A117.1 - Accessible and Usable Buildings and Facilities; 2009.

J. ITS (DIR) - Directory of Listed Products; current edition.

K. NAAMM HMMA 830 - Hardware Selection for Hollow Metal Doors and Frames; 2002.

L. NAAMM HMMA 831 - Hardware Locations for Hollow Metal Doors and Frames; 2011.

M. NAAMM HMMA 840 - Guide Specifications for Installation and Storage of Hollow Metal Doors and Frames; 2007.

N. NAAMM HMMA 860 - Guide Specifications for Hollow Metal Doors and Frames; 2013.

O. NAAMM HMMA 861 - Guide Specifications for Commercial Hollow Metal Doors and Frames; 2006.

P. NFPA 80 - Standard for Fire Doors and Other Opening Protectives; 2016.

Q. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies; 2012.

R. SDI 117 - Manufacturing Tolerances for Standard Steel Doors and Frames; 2013.

S. UL (DIR) - Online Certifications Directory; current listings at database.ul.com.

T. UL 10B - Standard for Fire Tests of Door Assemblies; Current Edition, Including All Revisions.

U. UL 10C - Standard for Positive Pressure Fire Tests of Door Assemblies; Current Edition, Including All Revisions.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Materials and details of design and construction, hardware locations, reinforcement type and locations, anchorage and fastening methods, and finishes; and one copy of referenced standards/guidelines.

C. Shop Drawings: Details of each opening, showing elevations, glazing, frame profiles, and any indicated finish requirements.

D. Manufacturer's Certificate: Certification that products meet or exceed specified requirements.

E. Manufacturer's Qualification Statement.

F. Installer's Qualification Statement.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years documented experience.

B. Maintain at project site copies of reference standards relating to installation of products specified.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Comply with NAAMM HMMA 840 or ANSI/SDI A250.8 (SDI-100) in accordance with specified requirements.

B. Protect with resilient packaging; avoid humidity build-up under coverings; prevent corrosion and adverse effects on factory applied painted finish.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Hollow Metal Doors and Frames:
   1. Ceco Door, an Assa Abloy Group company: www.assaabloydss.com.
   2. Republic Doors: www.republicdoor.com.
   3. Steelcraft, an Allegion brand: www.allegion.com/sle.
   4. Substitutions: See Section 01 6000 - Product Requirements.

2.02 PERFORMANCE REQUIREMENTS

A. Requirements for Hollow Metal Doors and Frames:
   1. Steel Sheet: Comply with one or more of the following requirements; galvannealed steel complying with ASTM A653/A653M, cold-rolled steel complying with ASTM A1008/A1008M, or hot-rolled pickled and oiled (HRPO) steel complying with ASTM A1011/A1011M, commercial steel (CS) Type B, for each.
   2. Accessibility: Comply with ICC A117.1 and ADA Standards.
   3. Exterior Door Top Closures: Flush end closure channel, with top and door faces aligned.
   4. Door Edge Profile: Manufacturers standard for application indicated.
   5. Typical Door Face Sheets: Flush.
   6. Glazed Lights: Non-removable stops on non-secure side; sizes and configurations as indicated on drawings. Style: Manufacturers standard.
   7. Hardware Preparations, Selections and Locations: Comply with NAAMM HMMA 830 and NAAMM HMMA 831 or BHMA A156.115 and ANSI/SDI A250.8 (SDI-100) in accordance with specified requirements.
   8. Zinc Coating for Typical Interior and/or Exterior Locations: Provide metal components zinc-coated (galvanized) and/or zinc-iron alloy-coated (galvannealed) by the hot-dip process in accordance with ASTM A653/A653M, with manufacturer's standard coating thickness, unless noted otherwise for specific hollow metal doors and frames.
      a. Based on SDI Standards: Provide at least A40/ZF120 (galvannealed) when necessary, coating not required for typical interior door applications, and at least A60/ZF180 (galvannealed) for corrosive locations.

B. Combined Requirements: If a particular door and frame unit is indicated to comply with more than one type of requirement, comply with the specified requirements for each type; for instance, an exterior door that is also indicated as being sound-rated must comply with the requirements specified for exterior doors and for sound-rated doors; where two requirements conflict, comply with the most stringent.

2.03 HOLLOW METAL DOORS

A. Exterior Doors: Thermally insulated.
   1. Based on SDI Standards: ANSI/SDI A250.8 (SDI-100).
      a. Level 1 - Standard-duty.
      b. Physical Performance Level C, 250,000 cycles; in accordance with ANSI/SDI A250.4.
      c. Model 1 - Full Flush.
      d. Door Face Metal Thickness: 20 gage, 0.032 inch, minimum.
      e. Zinc Coating: A60/ZF180 galvannealed coating; ASTM A653/A653M.
   2. Door Thermal Resistance: R-Value of 6.0 minimum, for installed thickness of polystyrene.
   3. Door Thickness: 1-3/4 inch, nominal.
   4. Door Face Sheets: Flush.
   5. Weatherstripping: Refer to Section 08 7100.
   6. Door Finish: Factory primed and field finished.

B. Interior Doors, Non-Fire Rated:
   1. Based on SDI Standards: ANSI/SDI A250.8 (SDI-100).
      a. Level 1 - Standard-duty.
      b. Physical Performance Level C, 250,000 cycles; in accordance with ANSI/SDI A250.4.
      c. Model 1 - Full Flush.
      d. Door Face Metal Thickness: 20 gage, 0.032 inch, minimum.
   2. Door Core Material: Manufacturers standard core material/construction and in compliance with requirements.
   3. Door Thickness: 1-3/4 inch, nominal.
   4. Door Finish: Factory primed and field finished.

C. Fire-Rated Doors:
   1. Based on SDI Standards: ANSI/SDI A250.8 (SDI-100).
      a. Level 1 - Standard-duty.
      b. Physical Performance Level C, 250,000 cycles; in accordance with ANSI/SDI A250.4.
      c. Model 1 - Full Flush.
      d. Door Face Metal Thickness: 20 gage, 0.032 inch, minimum.
      e. Zinc Coating: A60/ZF180 galvannealed coating; ASTM A653/A653M.
   2. Fire Rating: As indicated on Door Schedule, tested in accordance with UL 10C and NFPA 252 ("positive pressure fire tests").
      a. Provide units listed and labeled by UL (DIR) or ITS (DIR).
      b. Attach fire rating label to each fire rated unit.
   3. Door Core Material: Manufacturers standard core material/construction in compliance with requirements.
   4. Door Thickness: 1-3/4 inch, nominal.
   5. Door Finish: Factory primed and field finished.

2.04 HOLLOW METAL FRAMES

A. Comply with standards and/or custom guidelines as indicated for corresponding door in accordance with applicable door frame requirements.

B. Exterior Door Frames: Full profile/continuously welded type.
   1. Galvanizing: Components hot-dipped zinc-iron alloy-coated (galvannealed) in accordance with ASTM A653/A653M, with A40/ZF120 coating.
   2. Frame Metal Thickness: 18 gage, 0.042 inch, minimum.
   3. Frame Finish: Factory primed and field finished.
   4. Weatherstripping: Separate, see Section 08 7100.

C. Interior Door Frames, Non-Fire Rated: Full profile/continuously welded type.
   1. Terminated Stops: Provide at interior doors; closed end stop terminated 6 inch, maximum, above floor at 45 degree angle.
   2. Frame Metal Thickness: 18 gage, 0.042 inch, minimum.
   3. Frame Finish: Factory primed and field finished.

D. Door Frames, Fire-Rated: Full profile/continuously welded type.
   1. Fire Rating: Same as door, labeled.
   2. Terminated Stops: Provide at interior doors; closed end stop terminated 6 inch, maximum, above floor at 45 degree angle.
   3. Frame Metal Thickness: 18 gage, 0.042 inch, minimum.
   4. Frame Finish: Factory primed and field finished.

E. Mullions for Pairs of Doors: Fixed, except where removable is indicated, with profile similar to jambs.

F. Frames for Interior Glazing or Borrowed Lights: Construction and face dimensions to match interior door frames, and as indicated on drawings.

G. Transom Bars: Fixed, of profile same as jamb and head.

H. Provide mortar guard boxes for hardware cut-outs in frames to be installed in masonry or to be grouted.

I. Frames Wider than 48 inches: Reinforce with steel channel fitted tightly into frame head, flush with top.

J. Frames Installed Back-to-Back: Reinforce with steel channels anchored to floor and overhead structure.

2.05 ACCESSORIES

A. Louvers: Roll formed steel with overlapping frame; finish same as door components; factory-installed.
   1. In Fire-Rated Doors: UL (DIR) or ITS (DIR) listed fusible link louver, same rating as door.
   2. Style: Standard straight slat blade.
   3. Fasteners: Exposed or concealed fasteners.

B. Glazing: As specified in Section 08 8000, factory installed.

C. Removable Stops: Formed sheet steel, shape as indicated on drawings, mitered or butted corners; prepared for countersink style tamper proof screws.

D. Silencers: Resilient rubber, fitted into drilled hole; provide three on strike side of single door, three on center mullion of pairs, and two on head of pairs without center mullions.

E. Temporary Frame Spreaders: Provide for factory- or shop-assembled frames.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify that opening sizes and tolerances are acceptable.

C. Verify that finished walls are in plane to ensure proper door alignment.

3.02 PREPARATION

A. Coat inside of frames to be installed in masonry or to be grouted, with bituminous coating, prior to installation.

3.03 INSTALLATION

A. Install doors and frames in accordance with manufacturer's instructions and related requirements of specified door and frame standards or custom guidelines indicated.

B. Install fire rated units in accordance with NFPA 80.

C. Coordinate frame anchor placement with wall construction.

D. Install door hardware as specified in Section 08 7100.

E. Comply with glazing installation requirements of Section 08 8000.

F. Coordinate installation of electrical connections to electrical hardware items.

G. Touch up damaged factory finishes.

3.04 TOLERANCES

A. Clearances Between Door and Frame: Comply with related requirements of specified frame standards or custom guidelines indicated in accordance with SDI 117 or NAAMM HMMA 861.

B. Maximum Diagonal Distortion: 1/16 inch measured with straight edge, corner to corner.

3.05 ADJUSTING

A. Adjust for smooth and balanced door movement.

3.06 SCHEDULE

A. Refer to Door and Frame Schedule on the drawings.

END OF SECTION

SECTION 08 1116 - ALUMINUM DOORS AND FRAMES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Tubular aluminum doors.

B. Glazed aluminum doors.

C. Aluminum frames.

D. Accessories, including louvers, fasteners, and brackets.

1.02 RELATED REQUIREMENTS

A. Section 08 1416 - Flush Wood Doors: Wood doors to be installed in aluminum frames specified in this section.

B. Section 08 7100 - Door Hardware: Hardware for aluminum doors.

C. Section 08 8000 - Glazing: Glazing materials for aluminum doors and frames.

1.03 REFERENCE STANDARDS

A. AAMA 609 & 610 - Cleaning and Maintenance Guide for Architecturally Finished Aluminum (Combined Document); 2015.

B. AAMA 611 - Voluntary Specification for Anodized Architectural Aluminum; 2014 (2015 Errata).

C. AAMA 701/702 - Combined Voluntary Specifications for Pile Weatherstrip and Replaceable Fenestration Weatherseals; 2011.

D. AAMA 1503 - Voluntary Test Method for Thermal Transmittance and Condensation Resistance of Windows, Doors and Glazed Wall Sections; 2009.

E. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2015.

F. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2014.

G. ASTM B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric); 2014.

H. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2014.

I. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric); 2013.

J. ASTM E283 - Standard Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen; 2004 (Reapproved 2012).

K. ASTM E2112 - Standard Practice for Installation of Exterior Windows, Doors and Skylights; 2007 (Reapproved 2016).

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Manufacturer's descriptive literature for each type of door; include information on fabrication methods.

C. Shop Drawings: Include elevations of each opening type.
   1. Verify dimensions by field measurements before fabrication and indicate on shop drawings.

D. Test Report: Submit certified test reports from qualified independent testing agency indicating doors comply with specified performance requirements.

E. Warranty: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with not less than five years of documented experience.

B. Installer Qualifications: Company specializing in performing work of type specified and with at least three years of documented experience.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver aluminum components in manufacturer's standard protective packaging, palleted, crated, or banded together.

B. Inspect delivered components for damage and replace. Repaired components will not be accepted.

C. Store components in clean, dry, indoor area, under cover in manufacturer's packaging until installation.

D. Protect materials and finish from damage during handling and installation.

1.07 FIELD CONDITIONS

A. Do not begin installation of interior aluminum components until space has been enclosed and ambient thermal conditions are being maintained at levels consistent with final project requirements.

1.08 WARRANTY

A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.

B. Correct defective Work within a five year period after Date of Substantial Completion.

C. Provide ten year manufacturer warranty for defects in workmanship and materials.

PART 2 PRODUCTS

2.01 DOORS AND FRAMES

A. Glazed Aluminum Doors: Extruded aluminum tube frame, full glazed, with middle rail; factory glazed.
   1. Thickness: 1-3/4 inches, nominal.
   2. Stile Width: 5 inches, nominal.
   3. Finish: Colored anodized.
   4. Glazing: As specified in Section 08 8000.

B. Aluminum Frames for Doors, Sidelights, or Transoms: Extruded aluminum, non-thermally broken hollow or C-shaped sections; no steel components.
   1. Frame Depth: 4-1/4 inches.
   2. Finish: Class II - Color anodized.
   3. Weatherstripping: Replaceable pile type; at jambs and head.
   4. Sidelight/Transom Glazing: As specified in Section 08 8000.

C. Dimensions and Shapes: As indicated on drawings; dimensions indicated are nominal.
   1. Provide the following clearances:
      a. Hinge and Lock Stiles: 1/8 inch.
      b. Between Meeting Stiles: 1/4 inch.
      c. At Top Rail and Bottom Rail: 1/8 inch.

2.02 COMPONENTS

A. Tubular Doors: Extruded aluminum tubing, 1/8 inch minimum thickness, with heavy-duty plated steel through bolts in rails, glazing stops, and glazing gaskets.

B. Frames: Extruded aluminum shapes, not less than 0.062 inch thick, reinforced at hinge and strike locations.
   1. Corner Brackets: Extruded aluminum, fastened with stainless steel screws.
   2. Trim: Extruded aluminum, not less than 0.062 inch thick, removable snap-in type without exposed fasteners.

C. Door Hardware: Refer to Section 08 7100 for additional requirements.

2.03 PERFORMANCE REQUIREMENTS

A. Provide door assemblies that have been designed and fabricated in compliance with specified performance requirements.

B. Air Leakage: Maximum of 0.1 cu ft/min/sq ft at 6.27 psf differential pressure, when tested in accordance with ASTM E283.

C. Condensation Resistance Factor: 50, measured in accordance with AAMA 1503.

2.04 MATERIALS

A. Aluminum Sheet: ASTM B209 (ASTM B209M), alloy 5005, temper H14, stretcher leveled.

B. Extruded Aluminum: ASTM B221 (ASTM B221M), alloy 6063, temper T5, or alloy 6463, temper T5.

2.05 FINISHES

A. Class II Color Anodized Finish: Electrolytically deposited colored anodic coating; AAMA 611 AA-M12C22A34, minimum dry film thickness 0.4 mil.

2.06 FABRICATION

A. Door sizes shown are nominal; provide standard clearances as follows:
1. Hinge and Lock Stiles: 0.125 inch.
2. Between Meeting Stiles: 0.250 inch.
3. At Top Rail and Bottom Rail: 0.125 inch.

B. Aluminum frames: Sizes and contours as indicated on drawings.

2.07 ACCESSORIES

A. Replaceable Weatherstripping: AAMA 701/702 wool pile.

B. Fasteners: Aluminum, non-magnetic stainless steel, or other material warranted by manufacturer as non-corrosive and compatible with aluminum components.

C. Brackets and Reinforcements: Manufacturer's high-strength aluminum units where feasible, otherwise, non-magnetic stainless steel or steel hot-dip galvanized in compliance with ASTM A123/A123M.

D. Bituminous Coating: Cold-applied asphaltic mastic, compounded for 30-mil thickness per coat.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that wall surfaces and openings are ready to receive frames and are within tolerances specified in manufacturer's instructions.

3.02 PREPARATION

A. Perform cutting, fitting, forming, drilling, and grinding of frames as required for project conditions.

B. Replace components with damage to exposed finishes.

C. Separate dissimilar metals to prevent electrolytic action between metals.

3.03 INSTALLATION

A. Install doors and frames in accordance with manufacturer's instructions and approved shop drawings.

B. Install exterior doors and frames in accordance with ASTM E2112.

C. Set frames plumb, square, level, and aligned to receive doors. Anchor frames to adjacent construction in strict accordance with manufacturer's recommendations and within specified tolerances.

D. Where aluminum surfaces contact metals other than stainless steel, zinc, or small areas of white bronze, protect from direct contact by painting dissimilar metal with heavy coating of bituminous paint.

E. Hang doors and adjust hardware to achieve specified clearances and proper door operation.

F. Install door hardware as specified in Section 08 7100.

G. Comply with glazing installation requirements of Section 08 8000.

3.04 CLEANING

A. Upon completion of installation, thoroughly clean door and frame surfaces in accordance with AAMA 609 & 610.

B. Do not use abrasive, caustic, or acid cleaning agents.

3.05 PROTECTION

A. Protect products of this section from damage caused by subsequent construction until Date of Substantial Completion.

B. Replace damaged or defective components that cannot be repaired to a condition indistinguishable from undamaged components.

END OF SECTION

SECTION 08 1416 - FLUSH WOOD DOORS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Flush wood doors; flush and flush glazed configuration; fire rated and non-rated.

1.02 RELATED REQUIREMENTS

A. Section 08 1113 - Hollow Metal Doors and Frames.

B. Section 08 7100 - Door Hardware.

C. Section 08 8000 - Glazing.

1.03 REFERENCE STANDARDS

A. 16 CFR 1201 - Safety Standard for Architectural Glazing Materials; current edition.

B. ANSI A135.4 - American National Standard for Basic Hardboard; 2012.

C. ASTM C1048 - Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass; 2012.

D. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards; 2014.

E. AWMAC/WI (NAAWS) - North American Architectural Woodwork Standards, U.S. Version 3.0; 2016.

F. NEMA LD 3 - High-Pressure Decorative Laminates; 2005.

G. NFPA 80 - Standard for Fire Doors and Other Opening Protectives; 2016.

H. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies; 2012.

I. UL 10B - Standard for Fire Tests of Door Assemblies; Current Edition, Including All Revisions.

J. UL 10C - Standard for Positive Pressure Fire Tests of Door Assemblies; Current Edition, Including All Revisions.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Indicate door core materials and construction; veneer species, type and characteristics.

C. Shop Drawings: Show doors and frames, elevations, sizes, types, swings, undercuts, beveling, blocking for hardware, factory machining, factory finishing, cutouts for glazing and other details.

1. Provide information as required by AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS).

D. Certificate: Submit labels and certificates required by quality assurance and quality control programs.

E. Samples: Submit two samples of door construction, 8 by 8 inch in size cut from top corner of door.

F. Manufacturer's Installation Instructions: Indicate special installation instructions.

G. Warranty, executed in Owner's name.

1.05 QUALITY ASSURANCE

A. Maintain one copy of the specified door quality standard on site for review during installation and finishing.

B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section, with not less than three years of documented experience.
1. Company with at least one project within the past 5 years with value of woodwork within 20 percent of cost of woodwork for this project.
2. Accredited participant in the specified certification program prior to the commencement of fabrication and throughout the duration of the project.

C. Quality Certification:
1. Provide labels or certificates indicating that the installed work complies with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS) requirements for grade or grades specified.
2. Provide designated labels on shop drawings as required by certification program.
3. Provide designated labels on installed products as required by certification program.
4. Submit certifications upon completion of installation that verifies this work is in compliance with specified requirements.

D. Installed Fire Rated Door Assembly: Conform to NFPA 80 for fire-rating as indicated.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Package, deliver and store doors in accordance with specified quality standard.

B. Accept doors on site in manufacturer's packaging. Inspect for damage.

C. Protect doors with resilient packaging sealed with heat shrunk plastic. Do not store in damp or wet areas; or in areas where sunlight might bleach veneer. Seal top and bottom edges with tinted sealer if stored more than one week. Break seal on site to permit ventilation.

1.07 WARRANTY

A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.

B. Interior Doors: Provide manufacturer's warranty for the life of the installation.

C. Include coverage for delamination of veneer, warping beyond specified installation tolerances, defective materials, and telegraphing core construction.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Wood Veneer Faced Doors:
   1. Eggers Industries: www.eggersindustries.com.
   2. Graham Wood Doors: www.grahamdoors.com.
   3. Haley Brothers: www.haleybros.com.
   4. Marshfield DoorSystems, Inc: www.marshfielddoors.com.
   5. Oregon Door; Architectural Series: www.oregondoor.com/#sle.
   6. Substitutions: See Section 01 6000 - Product Requirements.

2.02 DOORS

A. Doors: Refer to drawings for locations and additional requirements.
   1. Quality Standard: Custom Grade, Heavy Duty performance, in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), unless noted otherwise.
   2. Wood Veneer Faced Doors: 5-ply or 7-ply unless otherwise indicated.

B. Interior Doors: 1-3/4 inches thick unless otherwise indicated; flush construction.
   1. Provide solid core doors at each location.
   2. Fire Rated Doors: Tested to ratings indicated on drawings in accordance with UL 10C - Positive Pressure; Underwriters Laboratories Inc (UL) or Intertek/Warnock Hersey (WHI) labeled without any visible seals when door is open.
   3. Wood veneer facing with factory transparent finish as indicated on drawings.

2.03 DOOR AND PANEL CORES

A. Non-Rated Solid Core and 20 Minute Rated Doors: Type particleboard core (PC), plies and faces as indicated.

B. Fire-Rated Doors: Mineral core type, with fire resistant composite core (FD), plies and faces as indicated above; with core blocking as required to provide adequate anchorage of hardware without through-bolting.

2.04 DOOR FACINGS

A. Veneer Facing for Transparent Finish: Select White Maple, veneer grade in accordance with quality standard indicated, plain sliced (flat cut), with book match between leaves of veneer, running match of spliced veneer leaves assembled on door or panel face.
   1. Vertical Edges: Same species as face veneer.
   2. "Pair Match" each pair of doors; "Set Match" pairs of doors within 10 feet of each other when doors are closed.

2.05 ACCESSORIES

A. Metal Louvers: Specified in Section 08 9100.

2.06 DOOR CONSTRUCTION

A. Fabricate doors in accordance with door quality standard specified.

B. Cores Constructed with stiles and rails:
   1. Provide solid blocks at lock edge for hardware reinforcement.
   2. Provide solid blocking for other throughbolted hardware.

C. Where supplementary protective edge trim is required, install trim after veneer facing has been applied full-width.

D. Glazed Openings: Non-removable stops on non-secure side; sizes and configurations as indicated on drawings.

E. Factory machine doors for hardware other than surface-mounted hardware, in accordance with hardware requirements and dimensions.

F. Factory fit doors for frame opening dimensions identified on shop drawings, with edge clearances in accordance with specified quality standard.

G. Provide edge clearances in accordance with the quality standard specified.

2.07 FACTORY FINISHING - WOOD VENEER DOORS

A. Finish work in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), Section 5 - Finishing for grade specified and as follows:
   1. Transparent:
      a. AWI TR-6 finish.
      b. Stain: clear finish.
      c. Sheen: standard factory sheen.

B. Factory finish doors in accordance with approved sample.

C. Seal door top edge with color sealer to match door facing.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify that opening sizes and tolerances are acceptable.

C. Do not install doors in frame openings that are not plumb or are out-of-tolerance for size or alignment.

3.02 INSTALLATION

A. Install doors in accordance with manufacturer's instructions and specified quality standard.
   1. Install fire-rated doors in accordance with NFPA 80 requirements.

B. Factory-Finished Doors: Do not field cut or trim; if fit or clearance is not correct, replace door.

C. Use machine tools to cut or drill for hardware.

D. Coordinate installation of doors with installation of frames and hardware.

E. Coordinate installation of glazing.

F. Install door louvers plumb and level.

3.03 TOLERANCES

A. Comply with specified quality standard for fit and clearance tolerances.

B. Comply with specified quality standard for telegraphing, warp, and squareness.

3.04 ADJUSTING

A. Adjust doors for smooth and balanced door movement.

B. Adjust closers for full closure.

3.05 SCHEDULE

A. Refer to Door and Frame Schedule included in drawings.

END OF SECTION

SECTION 08 3100 - ACCESS DOORS AND PANELS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Wall access door and frame units.

B. Ceiling access door and frame units.

1.02 RELATED REQUIREMENTS

A. Section 09 9000 - Painting and Coating: Field paint finish.

1.03 REFERENCE STANDARDS

A. UL (FRD) - Fire Resistance Directory; current edition.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide sizes, types, finishes, hardware, scheduled locations, and details of adjoining work.

C. Shop Drawings: Indicate exact position of each access door and/or panel unit.

D. Manufacturer's Installation Instructions: Indicate installation requirements.

E. Project Record Documents: Record actual locations of each access unit.

PART 2 PRODUCTS

2.01 ACCESS DOORS AND PANELS ASSEMBLIES

A. Wall-Mounted Units:
   1. Material: Steel.
   2. Size: 12 inch by 12 inch.
   3. Sized appropriately to access equipment inside of wall, including tool clearance.
   4. Door/Panel: Hinged, standard duty, with tool-operated spring or cam lock and no handle.
   5. Wall Mounting Criteria: Provide surface-mounted face frame and door surface flush with frame surface.

B. Wall-Mounted Units in Wet Areas:
   1. Material: Stainless steel, Type 304.
   2. Size: 12 inch by 12 inch.
   3. Door/Panel: Hinged, standard duty, with tool-operated spring or cam lock and no handle.

4. Wall Mounting Criteria: Provide surface-mounted face frame and door surface flush with frame surface.

C. Fire-Rated Wall-Mounted Units:
1. Wall Fire-Rating: As indicated on drawings.
2. Material: Steel.
3. Size: 12 inch by 12 inch.

D. Ceiling-Mounted Units:
1. Material: Steel.
2. Size - Lay-In Grid Ceilings: To match module of ceiling grid.
3. Size - Other Ceilings: 12 inch by 12 inch.
4. Door/Panel: Hinged, standard duty, with tool-operated spring or cam lock and no handle.

E. Fire-Rated Ceiling-Mounted Units:
1. Ceiling Fire-Rating: As indicated on drawings.
2. Material: Steel.
3. Size: 12 inch by 12 inch.
4. Door/Panel: Hinged, standard duty, with tool-operated spring or cam lock and no handle.

2.02 WALL AND CEILING MOUNTED UNITS

A. Manufacturers:
1. ACUDOR Products Inc: www.acudor.com/#sle.
2. Cendrex, Inc: www.cendrex.com/#sle.
3. Milcor, Inc: www.milcorinc.com.
4. Substitutions: See Section 01 6000 - Product Requirements.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that rough openings are correctly sized and located.

3.02 INSTALLATION

A. Install units in accordance with manufacturer's instructions.

B. Install frames plumb and level in openings, and secure units rigidly in place.

C. Position units to provide convenient access to concealed equipment when necessary.

END OF SECTION

SECTION 08 3313 - COILING COUNTER DOORS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Non-fire-rated coiling counter doors and operating hardware.

1.02 RELATED REQUIREMENTS

A. Section 06 1000 - Rough Carpentry: Rough openings.

B. Section 08 7100 - Door Hardware: Cylinder cores and keys.

C. Section 09 2116 - Gypsum Board Assemblies: Rough openings.

1.03 REFERENCE STANDARDS

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Submit manufacturer's standard literature showing materials and details of construction and finish.

C. Shop Drawings: Indicate rough and actual opening dimensions, anchorage methods, hardware locations, and installation details.

D. Samples: Submit two slats, 4 inch long, illustrating shape, color and finish texture.

E. Manufacturer's Instructions: Indicate installation sequence and installation, adjustment, and alignment procedures.

F. Operation and Maintenance Data: Indicate modes of operation, lubrication requirements and frequency, and periodic adjustments required.

G. Project Record Documents: Include as-built electrical diagrams for electrical operation and connection to fire alarm system.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Coiling Counter Doors:
   1. Alpine Overhead Doors, Inc; Wooden Counter Shutters: www.alpinedoors.com.
   2. Overhead Door Company; Model 665: www.overheaddoor.com

2.02 COILING COUNTER DOORS

A. Coiling Counter Doors, Non-Fire-Rated: Wood slat curtain.

1. Mounting: Interior face mounted.
2. Slats: Slats Constructed of interlocking, 1-3/4” x 3/4" thick wooden slats. They are held together by cables that run through vertical holes drilled in each slat at 22” intervals. .
3. Bottom Bar: Bottom Bar of curtain assembly is constructed of solid wood 5-5/8” x 1-5/8” thick with a deadbolt lock installed at both jambs.
4. Wood Species: Birch or White Oak.
5. Finish: Clear transparent.
6. Guides: Same material and finish unless otherwise indicated.
7. Hood Enclosure: Manufacturer's standard; Powder coated steel; Black.
8. Manual push up operation.
9. Locking Devices: Slide bolt on inside.

2.03 MATERIALS

A. Curtain Construction: Interlocking, single thickness slats.
   1. Slat Ends: Each slat fitted with end locks to act as wearing surface in guides and to prevent lateral movement.
   2. Curtain Bottom: Fitted with angles to provide reinforcement and positive contact in closed position.

B. Guide Construction: Wood, of profile to retain door in place, with mounting brackets of same material.

C. Hood Enclosure: Internally reinforced to maintain rigidity and shape.

D. Latching Mechanism: Inside mounted, adjustable keeper, spring activated latch bar feature to keep in locked or retracted position.

E. Slide Bolt: Provide on both-jamb sides, extending into slot in guides, with padlock on one side.

F. Roller Shaft Counterbalance: Steel pipe and torsion steel spring system, capable of producing torque sufficient to ensure smooth operation of curtain from any position and capable of holding position at mid-travel; with adjustable spring tension; requiring 25 lb nominal force to operate.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that opening sizes, tolerances and conditions are acceptable.

3.02 INSTALLATION

A. Install units in accordance with manufacturer's instructions.

B. Use anchorage devices to securely fasten assembly to wall construction and building framing without distortion or stress.

C. Securely and rigidly brace components suspended from structure. Secure guides to structural members only.

D. Fit and align assembly including hardware; level and plumb, to provide smooth operation.

3.03 TOLERANCES

A. Maintain dimensional tolerances and alignment with adjacent work.

B. Maximum Variation From Plumb: 1/16 inch.

C. Maximum Variation From Level: 1/16 inch.

D. Longitudinal or Diagonal Warp: Plus or minus 1/8 inch per 10 ft straight edge.

3.04 ADJUSTING

A. Adjust operating assemblies for smooth and noiseless operation.

3.05 CLEANING

A. Clean installed components.

B. Remove labels and visible markings.

3.06 **SCHEDULE**

A. Opening No. 1172e, Break Room.

END OF SECTION

SECTION 08 3323 - OVERHEAD COILING DOORS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Overhead coiling doors, operating hardware, exterior, electric operation.

B. Wiring from electric circuit disconnect to operator to control station.

1.02 RELATED REQUIREMENTS

A. Section 07 9200 - Joint Sealants: Sealing joints between frames and adjacent construction.

B. Section 09 9113 - Exterior Painting: Field paint finish.

C. Section 26 0583 - Wiring Connections: Power to disconnect.

1.03 REFERENCE STANDARDS

A. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2014.

B. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2015.

C. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2014.

D. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric); 2013.

E. ITS (DIR) - Directory of Listed Products; current edition.

F. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2014.

G. NEMA ICS 2 - Industrial Control and Systems Controllers, Contactors and Overload Relays Rated 600 Volts; 2000 (R2005), with errata, 2008.

H. UL (DIR) - Online Certifications Directory; current listings at database.ul.com.

I. UL 325 - Standard for Door, Drapery, Gate, Louver, and Window Operators and Systems; Current Edition, Including All Revisions.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide general construction, electrical equipment, and component connections and details.

C. Shop Drawings: Indicate pertinent dimensioning, anchorage methods, hardware locations, and installation details.

D. Samples: Submit two slats, 2 x 6 inch in size illustrating shape, color and finish texture.

E. Manufacturer's Installation Instructions: Indicate installation sequence and procedures, adjustment and alignment procedures.

F. Maintenance Data: Indicate lubrication requirements and frequency and periodic adjustments required.

1.05 QUALITY ASSURANCE

A. Products Requiring Electrical Connection: Listed and classified by ITS (DIR), UL (DIR), or testing firm acceptable to authorities having jurisdiction as suitable for purpose specified.

PART 2 PRODUCTS

2.01 MANUFACTURERS

2.02 COILING DOORS

A. Exterior Coiling Doors: Aluminum slat curtain.
   1. Capable of withstanding positive and negative wind loads of 20 psf, without undue deflection or damage to components.
   2. Sandwich slat construction with insulated core of foamed-in-place polyurethane insulation; minimum R-value of 8.1.
   3. Nominal Slat Size: 2 inches wide x required length.
   4. Finish: Anodized, color as selected.
   5. Guide, Angles: Galvanized steel.
   6. Hood Enclosure: Manufacturer's standard; primed steel.
   7. Electric operation.
   8. Mounting: As indicated on drawings.

2.03 MATERIALS AND COMPONENTS

A. Curtain Construction: Interlocking slats.
   1. Slat Ends: Each slat fitted with end locks to act as wearing surface in guides and to prevent lateral movement.
   2. Curtain Bottom: Fitted with angles to provide reinforcement and positive contact in closed position.
   3. Weatherstripping: Moisture and rot proof, resilient type, located at jamb edges, bottom of curtain, and where curtain enters hood enclosure of exterior doors.

B. Aluminum Slats: ASTM B221 (ASTM B221M), aluminum alloy Type 6063.

C. Guide Construction: Continuous, of profile to retain door in place with snap-on trim, mounting brackets of same metal.

D. Guides - Angle: ASTM A36/A36M metal angles, size as indicated.
   1. Hot-dip galvanized in compliance with ASTM A123/A123M.

E. Hood Enclosure and Trim: Internally reinforced to maintain rigidity and shape.

F. Lock Hardware:
   1. For motor operated units, additional lock or latching mechanisms are not required.

G. Roller Shaft Counterbalance: Steel pipe and helical steel spring system, capable of producing torque sufficient to ensure smooth operation of curtain from any position and capable of holding position at mid-travel; with adjustable spring tension; requiring 25 lb nominal force to operate.

2.04 ELECTRIC OPERATION

A. Operator, Controls, Actuators, and Safeties: Comply with UL 325; provide products listed by ITS (DIR), UL (DIR), or testing agency acceptable to authorities having jurisdiction.
   1. Provide interlock switches on motor operated units.

B. Electric Operators:
   1. Mounting: Side mounted.
   2. Motor Enclosure:
   3. Motor Rating: 1/3 hp; continuous duty.
   4. Motor Voltage: 120 volts, single phase, 60 Hz.
   5. Motor Controller: NEMA ICS 2, full voltage, reversing magnetic motor starter.
   6. Controller Enclosure: NEMA 250, Type 1.
   7. Opening Speed: 12 inches per second.
   8. Brake: Adjustable friction clutch type, activated by motor controller.
   9. Manual override in case of power failure.
   10. Refer to Section 26 0583 for electrical connections.

C. Control Station: Provide standard three button (Open-Close-Stop) momentary-contact control device for each operator complying with UL 325.
   1. 24 volt circuit.
   2. Recessed.
   3. Entrapment Protection Devices: Provide sensing devices and safety mechanisms complying with UL 325.
      a. Primary Device: Provide electric sensing edge, wireless sensing, NEMA 1 photo eye sensors, or NEMA 4X photo eye sensors as required with momentary-contact control device.

D. Safety Edge: Located at bottom of coiling door, full width, electro-mechanical sensitized type, wired to stop and reverse door direction upon striking object, hollow neoprene covered.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install units in accordance with manufacturer's instructions.

B. Use anchorage devices to securely fasten assembly to wall construction and building framing without distortion or stress.

C. Securely and rigidly brace components suspended from structure. Secure guides to structural members only.

D. Fit and align assembly including hardware; level and plumb, to provide smooth operation.

E. Complete wiring from disconnect to unit components.

F. Install enclosure and perimeter trim.

3.02 TOLERANCES

A. Maintain dimensional tolerances and alignment with adjacent work.

B. Maximum Variation From Plumb: 1/16 inch.

C. Maximum Variation From Level: 1/16 inch.

D. Longitudinal or Diagonal Warp: Plus or minus 1/8 inch per 10 ft straight edge.

3.03 ADJUSTING

A. Adjust operating assemblies for smooth and noiseless operation.

3.04 CLEANING

A. Clean installed components.

B. Remove labels and visible markings.

3.05 **SCHEDULE**

A. Opening No. 1067b, Exterior Door at Receiving 1067.

B. Opening No. 1069a and 1069b, Exterior Doors at Cart Storage 1069.

END OF SECTION

08 3400

BULLET RESISTANT ALUMINUM DOOR & FRAME ASSEMBLY

PART 1 GENERAL

1.1 REFERENCE

A. Underwriters Laboratory UL 752-Standard for Bullet Resisting Equipment, ASTM C 1172 - Standard Specification for Laminated Architectural Flat Glass, NIJ Standard 0108.01 - (National Institute of Justice) Standard for Ballistic Resistant Protective Materials (September, 1985). ASTM B 209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate, ASTM B 221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.

1.2 SUBMITTALS

A. The following shall be submitted by the manufacturer in accordance with Sections 13070 and any Special Contract Requirements: Submit for approval prior to fabrication: samples, product data (including preparation, storage and installation methods), cuts & anchor spacing, reinforcement & location , product specifications, shop drawings, test reports (current UL Listing Verification & UL 752 Test Results as provided by Underwriters Laboratories), and printed data in sufficient detail to indicate compliance with the contract documents.

B. Provide manufacturer's instructions for installation and cleaning of TSS Bullet Resistant Aluminum Door Assemblies. All required submittals shall be approved prior to installation.

1.3 DESIGN PERFORMANCE

A. Through the design, manufacturing techniques and material application the TSS Bullet Resistant Aluminum Door shall be constructed of an extruded aluminum in 6061-T6 alloy/tempered. With a UL Standard 752 Level 3 protection rating. Door and frame to have no exposed fasteners, corner joints shall consist of extruded and keyed aluminum spline with continuous 3/8" diameter steel tie rod at door top and bottom rails. All joints and connections shall be tight, providing hairline points and true alignment of adjacent members. Panels shall not be removable from threat side. Door system to be available in Right hand, left hand and reverse swings.

B. Standard door to defeat ballistic assaults from a .44 magnum superpower small arms handgun as tested with UL Standard 752 at Underwriters Laboratories.

C. Door stiles, top rails and bottom rails will be lined with hardened steel to meet Level 4 and 5 UL standards

1.4 QUALITY ASSURANCE

A. Manufacturer shall be a Company that specializes in manufacturing products of the specified type with a minimum of five years experience. Installer shall be a Company that specializes in product type specified. Manufacturer shall provide a sample with color/finish to the Architect for approval prior to start of work.

1.5 DELIVERY, STORAGE & HANDLING

A. Delivery the materials to the project with the manufacturer's UL Listed Labels intact and legible. Handle the materials with care to prevent damage. Store materials inside and under cover, stack flat and off floor. Project conditions (temperature, humidity, and ventilation) shall be within the maximum limit recommendations set by manufacturer. Do not install products that are under conditions outside these limits.

1.6 WARRANTY

A. All materials shall be warranted against defects for a period of 1 year for the date of receipt at the project site. . Certificates of manufacturer's standard limited warranty shall be provided at project completion.

PART 2 PRODUCTS

2.1ACCEPTABLE MANUFACTURERS

A. Products shall be manufactured by: Total Security Solutions, Inc, 170 National Park Drive, Fowlerville, MI 48836, 800-513-1468, Attn: Sales Department, info@tssbulletproof.com. Web: www.tssbulletproof.com . No substitutions shall be accepted.

2.2 PRODUCT: BULLET RESISTANT STOREFRONT FRAMING LEVEL 3

A. Bullet Resistant Door System: Total Security Solutions Bullet Resistant Aluminum TSS-BL3-DR Bullet Resistant Door System. All joints and connections shall be tight, providing hairline joints and true alignment of adjacent members. Corner joinery shall consist of heavy duty extruded and keyed aluminum corner splines with continuous 3/8 inch diameter tie rod construction. Glazing must not be removable from the threat side of the door. Provide to dimension heights and widths indicated on the Drawings.

1. System shall be designed to defeat ballistic assaults from a .44 magnum handgun in accordance with UL 752, Level 3.
   a. Standard Aluminum Doors: Top rail and stile 2-3/4" (70 mm), Bottom rail 8-1/2" (216 mm) including glass stops. Note: 5 ¼" wide stile rails available upon request
   b. Aluminum Door and Sidelight Frames and Extrusions: 1 ¾" (44mm) x 4" (102mm), Structural section .125" thickness
   c. Standard Glazing: LP-1250 Polycarbonate/Acrylic Laminate, 1-1/4" thick, 7.7lbs/sf. UL 752, UL=3, 44 mag. Note: Door can be glazed to meet levels 1-5 as per UL standards
   d. Hardware: Select SL-11HD continuous aluminum gear hinge, Adams Rite MS1850 deadlock, with Adams Rite 4510 Series mortise thumb turn and or Keyed mortise cylinder, 9" aluminum pull handle and door width push bar as selected by architect. LCN 400 series heavy duty door closer.

.

2. Door Frame Construction: Frames shall provide equal UL protection level as door, non-ricochet type, Aluminum ballistic extruded aluminum in 6061-T6 alloy, aluminum finish. Door hardware includes: HD continuous hinge, push/pull handle, mortised lock, overhead closer. Optional hardware: exit devices, electric strike plate, and custom security hardware. Shipped fabricated and ready for field installation.
   1) Sizes: 2 3/8" thick medium stile door rails with 1 ¾" x 4" BR aluminum jamb _____ *(specify color)*

B. Finish: Clear Anodized Aluminum, Dark Bronze Anodized Aluminum or Custom painted surface (organic acrylic enamel or Kynar High Performance Coating, please specify color) *(select one)*

PART 3 EXECUTION

3.1 PREPARATION

A. Prior to installing the bullet resistive material, the contractor shall verify that all supports have been installed as required by the contract documents and architectural drawings, and approved shop/CAD drawings, if required. Installer shall notify architect of any unsatisfactory preparation that is responsibility of another installer.

B. Clean and prepare all surfaces per manufacturers recommendations for achieving the best results for the substrate under the project conditions.

3.2 INSTALLATION

A. Do not begin installation until openings have been verified and surfaces properly prepared in accordance with Drawings. Install in accordance with manufacturer's instructions and UL 752. Set all equipment plumb.

B. TSS Bullet Resistant Aluminum Door shall be installed in accordance with manufacturer's instructions. Install plumb, level, square, true to line, and without warp or rack. Provide all fasteners required for installation. Anchor frames securely in place to supports. Use attachment methods permitting adjustment for construction tolerances, irregularities, alignment, and expansion and contraction. Separate aluminum from other metal surfaces with bituminous coatings or other means approved by Architect. Sheet Metal Flashing: Coordinate with sheet metal flashing as specified in Section 07620. Joint Sealants: Install joint sealants as specified in Section 07920.

3.3 POST APPLICATION

A. TSS Bullet Resistant Aluminum Door shall be installed in accordance with manufacturer's printed recommendations, including adhering to anchoring and finishing details. Method of application shall maintain the bullet resistive rating at junctures with concrete floor slabs, the concrete roof slabs, the bullet resistive door frames, the bullet resistive window frames and all required penetrations.

B. Inspection and Cleaning: Verify installation is complete and complies with manufacturer's requirements. Clean product and accessories, removing excess sealant, labels and protective covers.

C. Touch-up, repair or replace damaged products before Substantial Completion.

D. Product Warranty: Applicable warranty shall be issued to owner upon final release of completed project.

end of section

SECTION 08 4313 - ALUMINUM-FRAMED STOREFRONTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Aluminum-framed storefront, with vision glass.

B. Infill panels of spandrel glass.

C. Aluminum doors and frames.

D. Weatherstripping.

E. Door hardware.

1.02 RELATED REQUIREMENTS

A. Section 07 9200 - Joint Sealants: Sealing joints between frames and adjacent construction.

B. Section 08 4229 - Automatic Entrances.

C. Section 08 4413 - Glazed Aluminum Curtain Walls.

D. Section 08 5113 - Aluminum Windows: Operable sash within glazing system.

E. Section 08 7100 - Door Hardware: Hardware items other than specified in this section.

F. Section 08 8000 - Glazing: Glass and glazing accessories.

G. Section 12 2113 - Horizontal Louver Blinds: Attachments to framing members.

1.03 REFERENCE STANDARDS

A. AAMA CW-10 - Care and Handling of Architectural Aluminum From Shop to Site; 2015.

B. AAMA 609 & 610 - Cleaning and Maintenance Guide for Architecturally Finished Aluminum (Combined Document); 2015.

C. AAMA 611 - Voluntary Specification for Anodized Architectural Aluminum; 2014 (2015 Errata).

D. AAMA 1503 - Voluntary Test Method for Thermal Transmittance and Condensation Resistance of Windows, Doors and Glazed Wall Sections; 2009.

E. ASCE 7 - Minimum Design Loads for Buildings and Other Structures; 2010, with 2013 Supplements and Errata.

F. ASTM B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric); 2014.

G. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2014.

H. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric); 2013.

I. ASTM E283 - Standard Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen; 2004 (Reapproved 2012).

J. ASTM E330/E330M - Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference; 2014.

K. ASTM E331 - Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference; 2000 (Reapproved 2016).

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordinate with installation of other components that comprise the exterior enclosure.

B. Preinstallation Meeting: Conduct a preinstallation meeting one week before starting work of this section; require attendance by all affected installers.

1.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide component dimensions, describe components within assembly, anchorage and fasteners, glass and infill, internal drainage details.

C. Shop Drawings: Indicate system dimensions, framed opening requirements and tolerances, affected related work, expansion and contraction joint location and details, and field welding required.

D. Manufacturer's Certificate: Certify that the products supplied meet or exceed the specified requirements.

E. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.06 QUALITY ASSURANCE

A. Designer Qualifications: Design structural support framing components under direct supervision of a Professional Structural Engineer experienced in design of this Work and licensed in the State in which the Project is located.

B. Manufacturer Qualifications: Company specializing in performing work of type specified and with at least three years of documented experience.

C. Installer Qualifications: Company specializing in performing work of type specified and with at least three years of documented experience.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Handle products of this section in accordance with AAMA CW-10.

B. Protect finished aluminum surfaces with wrapping. Do not use adhesive papers or sprayed coatings that bond to aluminum when exposed to sunlight or weather.

1.08 FIELD CONDITIONS

A. Do not install sealants when ambient temperature is less than 40 degrees F. Maintain this minimum temperature during and 48 hours after installation.

1.09 WARRANTY

A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.

B. Correct defective Work within a five year period after Date of Substantial Completion.

C. Provide five year manufacturer warranty against failure of glass seal on insulating glass units, including interpane dusting or misting. Include provision for replacement of failed units.

D. Provide five year manufacturer warranty against excessive degradation of exterior finish. Include provision for replacement of units with excessive fading, chalking, or flaking.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Aluminum-Framed Storefront and Doors:
   1. EFCO Corporation: www.efcocorp.com.
   2. Kawneer North America: www.kawneer.com.
   3. Tubelite, Inc: www.tubeliteinc.com.
   4. Trulite Glass & Aluminum Solutions, LLC; CT451, 2 by 4-1/2 inch, center-set, insulating glazing, thermally broken, with 200 series narrow-stile doors: www.trulite.com.
   5. Substitutions: See Section 01 6000 - Product Requirements.

2.02 STOREFRONT

A. Aluminum-Framed Storefront: Factory fabricated, factory finished aluminum framing members with infill, and related flashings, anchorage and attachment devices.
   1. Glazing Position: Centered (front to back).
   2. Finish: Class I color anodized.
      a. Factory finish all surfaces that will be exposed in completed assemblies.
   3. Finish Color: As indicated on the drawings.
   4. Fabrication: Joints and corners flush, hairline, and weatherproof, accurately fitted and secured; prepared to receive anchors and hardware; fasteners and attachments concealed from view; reinforced as required for imposed loads.
   5. Construction: Eliminate noises caused by wind and thermal movement, prevent vibration harmonics, and prevent "stack effect" in internal spaces.

6. System Internal Drainage: Drain to the exterior by means of a weep drainage network any water entering joints, condensation occurring in glazing channel, and migrating moisture occurring within system.
7. Expansion/Contraction: Provide for expansion and contraction within system components caused by cycling temperature range of 170 degrees F over a 12 hour period without causing detrimental effect to system components, anchorages, and other building elements.
8. Movement: Allow for movement between storefront and adjacent construction, without damage to components or deterioration of seals.
9. Perimeter Clearance: Minimize space between framing members and adjacent construction while allowing expected movement.
10. Air and Vapor Seal: Maintain continuous air barrier and vapor retarder throughout assembly, primarily in line with inside pane of glazing and inner sheet of infill panel and heel bead of glazing compound.
11. Preparation for Window Treatments: Provide reinforced interior horizontal head rail.

B. Performance Requirements:
1. Wind Loads: Design and size components to withstand the specified load requirements without damage or permanent set, when tested in accordance with ASTM E330/E330M, using loads 1.5 times the design wind loads and 10 second duration of maximum load.
a. Design Wind Loads: Comply with requirements of ASCE 7.
b. Member Deflection: Limit member deflection to flexure limit of glass in any direction, with full recovery of glazing materials.
2. Water Penetration Resistance on Manufactured Assembly: No uncontrolled water on interior face, when tested in accordance with ASTM E331 at pressure differential of 8 psf.
3. Air Leakage Laboratory Test: Maximum of 0.06 cu ft/min sq ft of wall area, when tested in accordance with ASTM E283 at 6.27 psf pressure differential across assembly.
4. Condensation Resistance Factor of Framing: 50, minimum, measured in accordance with AAMA 1503.

2.03 COMPONENTS

A. Aluminum Framing Members: Tubular aluminum sections, thermally broken with interior section insulated from exterior, drainage holes and internal weep drainage system.
1. Glazing Stops: Flush.
2. Structurally Reinforced Members: Extruded aluminum with internal reinforcement of structural steel member.

B. Glazing: As specified in Section 08 8000.

2.04 MATERIALS

A. Extruded Aluminum: ASTM B221 (ASTM B221M).

B. Fasteners: Stainless steel.

C. Glazing Gaskets: Type to suit application to achieve weather, moisture, and air infiltration requirements.

2.05 FINISHES

A. Class I Color Anodized Finish: AAMA 611 AA-M12C22A44 Electrolytically deposited colored anodic coating not less than 0.7 mils thick.

B. Color: As indicated on drawings.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify dimensions, tolerances, and method of attachment with other work.

B. Verify that wall openings and adjoining air and vapor seal materials are ready to receive work of this section.

3.02 INSTALLATION

A. Install wall system in accordance with manufacturer's instructions.

B. Attach to structure to permit sufficient adjustment to accommodate construction tolerances and other irregularities.

C. Provide alignment attachments and shims to permanently fasten system to building structure.

D. Align assembly plumb and level, free of warp or twist. Maintain assembly dimensional tolerances, aligning with adjacent work.

E. Provide thermal isolation where components penetrate or disrupt building insulation.

F. Install sill flashings. Turn up ends and edges; seal to adjacent work to form water tight dam.

G. Where fasteners penetrate sill flashings, make watertight by seating and sealing fastener heads to sill flashing.

H. Pack fibrous insulation in shim spaces at perimeter of assembly to maintain continuity of thermal barrier.

I. Install hardware using templates provided.

J. Install glass and infill panels in accordance with Section 08 8000, using glazing method required to achieve performance criteria.

K. Touch-up minor damage to factory applied finish; replace components that cannot be satisfactorily repaired.

3.03 TOLERANCES

A. Maximum Variation from Plumb: 0.06 inch per 3 feet non-cumulative or 0.06 inch per 10 feet, whichever is less.

B. Maximum Misalignment of Two Adjoining Members Abutting in Plane: 1/32 inch.

3.04 FIELD QUALITY CONTROL

3.05 CLEANING

A. Remove protective material from pre-finished aluminum surfaces.

B. Upon completion of installation, thoroughly clean aluminum surfaces in accordance with AAMA 609 & 610.

3.06 PROTECTION

A. Protect installed products from damage until Date of Substantial Completion.

END OF SECTION

SECTION 08 4413 - GLAZED ALUMINUM CURTAIN WALLS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Aluminum-framed sloped curtain wall, self-supporting, with vision glazing.

1.02 RELATED REQUIREMENTS

A. Section 08 4313 - Aluminum-Framed Storefronts: Entrance framing and doors.

1.03 REFERENCE STANDARDS

A. AAMA CW-10 - Care and Handling of Architectural Aluminum From Shop to Site; 2015.

B. AAMA 501.2 - Quality Assurance and Diagnostic Water Leakage Field Check of Installed Storefronts, Curtain Walls, and Sloped Glazing Systems; 2015.

C. AAMA 503 - Voluntary Specification for Field Testing of Newly Installed Storefronts, Curtain Walls and Sloped Glazing Systems; 2014.

D. AAMA 609 & 610 - Cleaning and Maintenance Guide for Architecturally Finished Aluminum (Combined Document); 2015.

E. AAMA 611 - Voluntary Specification for Anodized Architectural Aluminum; 2014 (2015 Errata).

F. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2014.

G. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric); 2013.

H. ASTM E283 - Standard Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen; 2004 (Reapproved 2012).

I. ASTM E330/E330M - Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference; 2014.

J. ASTM E1105 - Standard Test Method for Field Determination of Water Penetration of Installed Exterior Windows, Skylights, Doors, and Curtain Walls, by Uniform or Cyclic Static Air Pressure Difference; 2015.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordinate with installation of other components that comprise the exterior enclosure.

B. Preinstallation Meeting: Conduct a preinstallation meeting one week before starting work of this section; require attendance by all affected installers.

1.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide component dimensions, describe components within assembly, anchorage and fasteners, internal drainage details, glazing, and infill.

C. Shop Drawings: Indicate system dimensions, framed opening requirements and tolerances, affected related Work, expansion and contraction joint location and details, and field welding required.

D. Shop Drawings: Provide details of proposed structural sealant glazing (SSG) and weather sealant joints indicating dimensions, materials, bite, thicknesses, profile, and support framing.

E. Manufacturer's Certificate: Certify that the products supplied meet or exceed the specified requirements.

F. Design Data: Provide framing member structural and physical characteristics and engineering calculations, and identify dimensional limitations; include load calculations at points of attachment to building structure.

G. Structural Sealant Glazing (SSG): Submit product data and calculations showing compliance with performance requirements.

H. Test Reports: Submit results of full-size mock-up testing. Reports of tests previously performed on the same design are acceptable.

I. Field Quality Control Submittals: Report of field testing for water penetration and air leakage.

J. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.06 QUALITY ASSURANCE

A. Designer Qualifications: Design curtain wall and its structural support framing components under direct supervision of a Professional Structural Engineer experienced in design of this work and licensed at the State in which the Project is located.

B. Verify that each component is appropriate for use in structural sealant glazing (SSG) application in regards to at least the following properties; size, shape, dimensions, material, self-life, storage conditions, and color.

C. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with not less than three years of documented experience.

D. Installer Qualifications: Company specializing in performing work of type specified and with at least three years of documented experience.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Handle products of this section in accordance with AAMA CW-10.

B. Protect finished aluminum surfaces with wrapping. Do not use adhesive papers or sprayed coatings that bond to aluminum when exposed to sunlight or weather.

1.08 FIELD CONDITIONS

A. Do not install sealants when ambient temperature is less than 40 degrees F. Maintain this minimum temperature during and 48 hours after installation.

1.09 WARRANTY

A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.

B. Correct defective Work within a five year period after Date of Substantial Completion.

C. Provide five year manufacturer warranty against failure of glass seal on insulating glass units, including interpane dusting or misting. Include provision for replacement of failed units.

D. Provide five year manufacturer warranty against excessive degradation of exterior finish. Include provision for replacement of units with excessive fading, chalking, or flaking.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Glazed Aluminum Curtain Walls:
1. EFCO, a Pella Company; 5500: www.efcocorp.com/#sle.
2. Kawneer North America: www.kawneer.com.
3. Oldcastle Building Envelope: www.oldcastlebe.com.
4. Tubelite, Inc: www.tubeliteinc.com.
5. Trulite Glass & Aluminum Solutions, LLC: www.trulite.com.
6. Substitutions: See Section 01 6000 - Product Requirements.

2.02 CURTAIN WALL

A. Aluminum-Framed Curtain Wall: Factory fabricated, factory finished aluminum framing members with infill, and related flashings, anchorage and attachment devices.
1. Finish: Class I color anodized.
   a. Factory finish surfaces that will be exposed in completed assemblies.
   b. Coat concealed metal surfaces that will be in contact with cementitious materials or dissimilar metals with bituminous paint.
2. Provide flush joints and corners, weathersealed, accurately fitted and secured; prepared to receive anchors; fasteners and attachments concealed from view; reinforced as required for imposed loads.
3. Construction: Eliminate noises caused by wind and thermal movement, prevent vibration harmonics, and prevent "stack effect" in internal spaces.
4. System Internal Drainage: Drain to the exterior by means of a weep drainage network any water entering joints, condensation occurring in glazing channel, and migrating moisture occurring within system.

B. Structural Performance Requirements: Design and size components to withstand the following load requirements without damage or permanent set.
   1. Design Wind Loads: Comply with the following:
      a. Positive Design Wind Load: 45 lbf/sq ft.
      b. Negative Design Wind Load: 35 lbf/sq ft.
      c. Measure performance by testing in accordance with ASTM E330/E330M, using test loads equal to 1.5 times the design wind loads and 10 second duration of maximum pressure.
   2. Movement: Accommodate the following movement without damage to components or deterioration of seals:
      a. Expansion and contraction caused by 180 degrees F surface temperature.
      b. Expansion and contraction caused by cycling temperature range of 170 degrees F over a 12 hour period.
      c. Movement of curtain wall relative to perimeter framing.
      d. Deflection of structural support framing, under permanent and dynamic loads.

C. Water Penetration Resistance on Manufactured Assembly: No uncontrolled water on indoor face when tested as follows:
   1. Test Pressure Differential: 10 psf.

D. Air Leakage Laboratory Test: Maximum of 0.06 cu ft/min sq ft of wall area, when tested in accordance with ASTM E283 at 6.27 psf pressure differential across assembly.

2.03 COMPONENTS

A. Aluminum Framing Members: Tubular aluminum sections, thermally broken with interior section insulated from exterior, drainage holes and internal weep drainage system.

B. Glazing: As specified in Section 08 8000.

2.04 MATERIALS

A. Extruded Aluminum: ASTM B221 (ASTM B221M).

B. Glazing Gaskets: Type to suit application to achieve weather, moisture, and air infiltration requirements.

C. Glazing Accessories: As specified in Section 08 8000.

2.05 FINISHES

A. Class I Color Anodized Finish: AAMA 611 AA-M12C22A42 Integrally colored anodic coating not less than 0.7 mils thick.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify dimensions, tolerances, and method of attachment with other related work.

B. Verify that curtain wall openings and adjoining air and vapor seal materials are ready to receive work of this section.

C. Verify that anchorage devices have been properly installed and located.

3.02 INSTALLATION

A. Install curtain wall system in accordance with manufacturer's instructions.

B. Attach to structure to permit sufficient adjustment to accommodate construction tolerances and other irregularities.

C. Provide alignment attachments and shims to permanently fasten system to building structure.

D. Align assembly plumb and level, free of warp or twist. Maintain assembly dimensional tolerances, aligning with adjacent work.

E. Provide thermal isolation where components penetrate or disrupt building insulation.

F. Install sill flashings. Turn up ends and edges; seal to adjacent work to form water tight dam.

G. Touch-up minor damage to factory applied finish; replace components that cannot be satisfactorily repaired.

3.03 TOLERANCES

A. Maximum Variation from Plumb: 0.06 inches every 3 ft non-cumulative or 0.5 inches per 100 ft, whichever is less.

B. Maximum Misalignment of Two Adjoining Members Abutting in Plane: 1/32 inch.

C. Sealant Space Between Curtain Wall Mullions and Adjacent Construction: Maximum of 3/4 inch and minimum of 1/4 inch.

3.04 FIELD QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements, for independent field testing and inspection requirements, and requirements for monitoring quality of specified product installations.

B. Water-Spray Test: Provide water spray quality test of installed curtain wall components in accordance with AAMA 501.2 during construction process and before installation of interior finishes.
   1. Perform a minimum of two tests in each designated area as indicated on drawings.
   2. Conduct tests in each area prior to 10 percent and 50 percent completion of this work.

C. Provide field testing of installed curtain wall system by independent laboratory in accordance with AAMA 503 during construction process and before installation of interior finishes.
   1. Perform a minimum of two tests in each designated area as indicated on drawings.
   2. Conduct tests in each area prior to 10 percent and 50 percent completion of this work.
   3. Field test for water penetration in accordance with ASTM E1105 with uniform static air pressure difference (Procedure A) not less than 4.18 psf.

a. Maximum allowable rate of water penetration in 15-minute test is 0.5 ounce that is not contained in an area with provisions to drain to exterior, or collected on surface of interior horizontal framing member.

D. Repair or replace curtain wall components that have failed designated field testing, and retest to verify performance conforms to specified requirements.

3.05 CLEANING

A. Remove protective material from pre-finished aluminum surfaces.

B. Wash down surfaces with a solution of mild detergent in warm water, applied with soft, clean wiping cloths, take care to remove dirt from corners, and wipe surfaces clean.

C. Upon completion of installation, thoroughly clean aluminum surfaces in accordance with AAMA 609 & 610.

3.06 PROTECTION

A. Protect installed products from damage until Date of Substantial Completion.

3.07 **SCHEDULE**

A. Note that Larger sized windows, 10'-0" in height and above, may be required to be Glazed Aluminum Curtain Wall Systems. Contractor to coordinate with the manufacturer to provide the most cost efficient option and call it out as such in shop drawings and submittals.

END OF SECTION

SECTION 087100 – DOOR HARDWARE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes commercial door hardware for the following:

1. Swinging doors.
2. Sliding doors.
3. Other doors to the extent indicated.

B. Door hardware includes, but is not necessarily limited to, the following:

1. Mechanical door hardware.
2. Electromechanical door hardware.
3. Cylinders specified for doors in other sections.

C. Related Sections:

1. Division 08 Section “Door Hardware Schedule”.
2. Division 08 Section “Hollow Metal Doors and Frames”.
3. Division 08 Section “Flush Wood Doors”.
4. Division 08 Section “Access Control Hardware”.
5. Division 28 Section “Access Control”.

D. Codes and References: Comply with the version year adopted by the Authority Having Jurisdiction.

1. ANSI A117.1 - Accessible and Usable Buildings and Facilities.
2. ICC/IBC - International Building Code.
3. NFPA 70 - National Electrical Code.
4. NFPA 80 - Fire Doors and Windows.
5. NFPA 101 - Life Safety Code.
6. NFPA 105 - Installation of Smoke Door Assemblies.
7. State Building Codes, Local Amendments.

E. Standards: All hardware specified herein shall comply with the following industry standards:

1. ANSI/BHMA Certified Product Standards - A156 Series

2. UL10C – Positive Pressure Fire Tests of Door Assemblies

1.3 SUBMITTALS

A. Product Data: Manufacturer's product data sheets including installation details, material descriptions, dimensions of individual components and profiles, operational descriptions and finishes.

B. Door Hardware Schedule: Prepared by or under the supervision of supplier, detailing fabrication and assembly of door hardware, as well as procedures and diagrams. Coordinate the final Door Hardware Schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.

1. Format: Comply with scheduling sequence and vertical format in DHI's "Sequence and Format for the Hardware Schedule."

2. Organization: Organize the Door Hardware Schedule into door hardware sets indicating complete designations of every item required for each door or opening. Organize door hardware sets in same order as in the Door Hardware Sets at the end of Part 3. Submittals that do not follow the same format and order as the Door Hardware Sets will be rejected and subject to resubmission.

3. Content: Include the following information:

a. Type, style, function, size, label, hand, and finish of each door hardware item.
b. Manufacturer of each item.
c. Fastenings and other pertinent information.
d. Location of door hardware set, cross-referenced to Drawings, both on floor plans and in door and frame schedule.
e. Explanation of abbreviations, symbols, and codes contained in schedule.
f. Mounting locations for door hardware.
g. Door and frame sizes and materials.
h. Warranty information for each product.

4. Submittal Sequence: Submit the final Door Hardware Schedule at earliest possible date, particularly where approval of the Door Hardware Schedule must precede fabrication of other work that is critical in the Project construction schedule. Include Product Data, Samples, Shop Drawings of other work affected by door hardware, and other information essential to the coordinated review of the Door Hardware Schedule.

C. Shop Drawings: Details of electrified access control hardware indicating the following:

1. Wiring Diagrams: Upon receipt of approved schedules, submit detailed system wiring diagrams for power, signaling, monitoring, communication, and control of the access control system electrified hardware. Differentiate between manufacturer-installed and field-installed wiring. Include the following:

a. Elevation diagram of each unique access controlled opening showing location and interconnection of major system components with respect to their placement in the respective door openings.
b. Complete (risers, point-to-point) access control system block wiring diagrams.
c. Wiring instructions for each electronic component scheduled herein.

2. Electrical Coordination: Coordinate with related sections the voltages and wiring details required at electrically controlled and operated hardware openings.

D. Keying Schedule: After a keying meeting with the owner has taken place prepare a separate keying schedule detailing final instructions. Submit the keying schedule in electronic format. Include keying system explanation, door numbers, key set symbols, hardware set numbers and special instructions. Owner must approve submitted keying schedule prior to the ordering of permanent cylinders/cores.

E. Informational Submittals:

1. Product Test Reports: Indicating compliance with cycle testing requirements, based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified independent testing agency.

F. Operating and Maintenance Manuals: Provide manufacturers operating and maintenance manuals for each item comprising the complete door hardware installation in quantity as required in Division 01, Closeout Submittals.

1.4 QUALITY ASSURANCE

A. Manufacturers Qualifications: Engage qualified manufacturers with a minimum 5 years of documented experience in producing hardware and equipment similar to that indicated for this Project and that have a proven record of successful in-service performance.

B. Installer Qualifications: A minimum 3 years documented experience installing both standard and electrified door hardware similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.

C. Door Hardware Supplier Qualifications: Experienced commercial door hardware distributors with a minimum 5 years documented experience supplying both mechanical and electromechanical hardware installations comparable in material, design, and extent to that indicated for this Project. Supplier recognized as a factory direct distributor by the manufacturers of the primary materials with a warehousing facility in Project's vicinity. Supplier to have on staff a certified Architectural Hardware Consultant (AHC) available during the course of the Work to consult with Contractor, Architect, and Owner concerning both standard and electromechanical door hardware and keying.

D. Source Limitations: Obtain each type and variety of door hardware specified in this section from a single source unless otherwise indicated.

1. Electrified modifications or enhancements made to a source manufacturer's product line by a secondary or third party source will not be accepted.

2. Provide electromechanical door hardware from the same manufacturer as mechanical door hardware, unless otherwise indicated.

E. Each unit to bear third party permanent label demonstrating compliance with the referenced standards.

F. Keying Conference: Conduct conference to comply with requirements in Division 01 Section "Project Meetings." Keying conference to incorporate the following criteria into the final keying schedule document:

1. Function of building, purpose of each area and degree of security required.
2. Plans for existing and future key system expansion.
3. Requirements for key control storage and software.
4. Installation of permanent keys, cylinder cores and software.
5. Address and requirements for delivery of keys.

G. Pre-Submittal Conference: Conduct coordination conference in compliance with requirements in Division 01 Section "Project Meetings" with attendance by representatives of Supplier(s), Installer(s), and Contractor(s) to review proper methods and the procedures for receiving, handling, and installing door hardware.

1. Prior to installation of door hardware, conduct a project specific training meeting to instruct the installing contractors' personnel on the proper installation and adjustment of their respective products. Product training to be attended by installers of door hardware (including electromechanical hardware) for aluminum, hollow metal and wood doors. Training will include the use of installation manuals, hardware schedules, templates and physical product samples as required.
2. Inspect and discuss electrical roughing-in, power supply connections, and other preparatory work performed by other trades.
3. Review sequence of operation narratives for each unique access controlled opening.
4. Review and finalize construction schedule and verify availability of materials.
5. Review the required inspecting, testing, commissioning, and demonstration procedures

H. At completion of installation, provide written documentation that components were applied to manufacturer's instructions and recommendations and according to approved schedule.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Inventory door hardware on receipt and provide secure lock-up and shelving for door hardware delivered to Project site. Do not store electronic access control hardware, software or accessories at Project site without prior authorization.

B. Tag each item or package separately with identification related to the final Door Hardware Schedule, and include basic installation instructions with each item or package.

C. Deliver, as applicable, permanent keys, cylinders, cores, access control credentials, software and related accessories directly to Owner via registered mail or overnight package service. Instructions for delivery to the Owner shall be established at the "Keying Conference".

1.6 COORDINATION

A. Templates: Obtain and distribute to the parties involved templates for doors, frames, and other work specified to be factory prepared for installing standard and electrified hardware. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing hardware to comply with indicated requirements.

B. Door Hardware and Electrical Connections: Coordinate the layout and installation of scheduled electrified door hardware and related access control equipment with required connections to source power junction boxes, low voltage power supplies, detection and monitoring hardware, and fire and detection alarm systems.

C. Door and Frame Preparation: Doors and corresponding frames are to be prepared, reinforced and pre-wired (if applicable) to receive the installation of the specified electrified, monitoring, signaling and access control system hardware without additional in-field modifications.

1.7 WARRANTY

A. General Warranty: Reference Division 01, General Requirements. Special warranties specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.

B. Warranty Period: Written warranty, executed by manufacturer(s), agreeing to repair or replace components of standard and electrified door hardware that fails in materials or workmanship within specified warranty period after final acceptance by the Owner. Failures include, but are not limited to, the following:

1. Structural failures including excessive deflection, cracking, or breakage.
2. Faulty operation of the hardware.
3. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
4. Electrical component defects and failures within the systems operation.

C. Standard Warranty Period: One year from date of Substantial Completion, unless otherwise indicated.

D. Special Warranty Periods:
1. Seven years for heavy duty cylindrical (bored) locks and latches.
2. Five years for exit hardware.
3. Five years for motorized electric latch retraction exit devices.
4. Two years for electromechanical door hardware.

1.8 MAINTENANCE SERVICE

A. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions as needed for Owner's continued adjustment, maintenance, and removal and replacement of door hardware.

PART 2 - PRODUCTS

2.1 SCHEDULED DOOR HARDWARE

A. General: Provide door hardware for each door to comply with requirements in Door Hardware Sets and each referenced section that products are to be supplied under.

B. Designations: Requirements for quantity, item, size, finish or color, grade, function, and other distinctive qualities of each type of door hardware are indicated in the Door Hardware Sets at the end of Part 3. Products are identified by using door hardware designations, as follows:

1. Named Manufacturer's Products: Product designation and manufacturer are listed for each door hardware type required for the purpose of establishing requirements. Manufacturers' names are abbreviated in the Door Hardware Schedule.

C. Substitutions: Requests for substitution and product approval for inclusive mechanical and electromechanical door hardware in compliance with the specifications must be submitted in writing and in accordance with the procedures and time frames outlined in Division 01, Substitution Procedures. Approval of requests is at the discretion of the architect, owner, and their designated consultants.

2.2 HANGING DEVICES

A. Hinges: ANSI/BHMA A156.1 certified butt hinges with number of hinge knuckles and other options as specified in the Door Hardware Sets.

1. Quantity: Provide the following hinge quantity:

a. Two Hinges: For doors with heights up to 60 inches.
b. Three Hinges: For doors with heights 61 to 90 inches.
c. Four Hinges: For doors with heights 91 to 120 inches.
d. For doors with heights more than 120 inches, provide 4 hinges, plus 1 hinge for every 30 inches of door height greater than 120 inches.

2. Hinge Size: Provide the following, unless otherwise indicated, with hinge widths sized for door thickness and clearances required:

a. Widths up to 3’0”: 4-1/2” standard or heavy weight as specified.
b. Sizes from 3’1” to 4’0”: 5” standard or heavy weight as specified.

3. Hinge Weight and Base Material: Unless otherwise indicated, provide the following:

a. Exterior Doors: Heavy weight, non-ferrous, ball bearing or oil impregnated bearing hinges unless Hardware Sets indicate standard weight.
b. Interior Doors: Standard weight, steel, ball bearing or oil impregnated bearing hinges unless Hardware Sets indicate heavy weight.

4. Hinge Options: Comply with the following:

a. Non-removable Pins: Provide set screw in hinge barrel that, when tightened into a groove in hinge pin, prevents removal of pin while door is closed; for the all out-swinging lockable doors.

5. Manufacturers:

a. Bommer Industries (BO).
b. McKinney Products; ASSA ABLOY Architectural Door Accessories (MK).
c. Stanley Hardware (ST).

B. Continuous Geared Hinges: ANSI/BHMA A156.26 Grade 1-600 certified continuous geared hinge. with minimum 0.120-inch thick extruded 6060 T6 aluminum alloy hinge leaves and a minimum overall width of 4 inches. Hinges are non-handed, reversible and fabricated to template screw locations. Factory trim hinges to suit door height and prepare for electrical cut-outs.

1. Manufacturers:

a. Bommer Industries (BO).
b. Pemko Products; ASSA ABLOY Architectural Door Accessories (PE).
c. Stanley Hardware (ST).

C. Sliding and Folding Door Hardware: Hardware is to be of type and design as specified and should comply with ANSI/BHMA A156.14.

1. Sliding Bi-Passing Pocket Door Hardware: Provide complete sets consisting of track, hangers, stops, bumpers, floor channel, guides, and accessories indicated.

2. Pocket Sliding Door Hardware: Rated for doors weighing up to 200 lb.

3. Manufacturers:

a. Hager Companies (HA).
b. Johnson Hardware (JO).
c. Pemko Products; ASSA ABLOY Architectural Door Accessories (PE).

2.3 POWER TRANSFER DEVICES

A. Electrified Quick Connect Continuous Geared Transfer Hinges: Provide electrified transfer continuous geared hinges with a 12" removable service panel cutout accessible without de-mounting door from the frame. Furnish with Molex™ standardized plug connectors with sufficient number of concealed wires (up to 12) to accommodate the electrified functions

specified in the Door Hardware Sets. Connectors plug directly to through-door wiring harnesses for connection to electric locking devices and power supplies. Wire nut connections are not acceptable.

1. Manufacturers:

    a. Bommer Industries (BO) - SER-QC (# of wires) Option.
    b. McKinney Products; ASSA ABLOY Architectural Door Accessories (MK) - SER-QC (# wires) Option.
    c. Pemko Products; ASSA ABLOY Architectural Door Accessories (PE) - SER-QC (# wires) Option.

B. Concealed Quick Connect Electric Power Transfers: Provide concealed wiring pathway housing mortised into the door and frame for low voltage electrified door hardware. Furnish with Molex™ standardized plug connectors and sufficient number of concealed wires (up to 12) to accommodate the electrified functions specified in the Door Hardware Sets. Connectors plug directly to through-door wiring harnesses for connection to electric locking devices and power supplies. Wire nut connections are not acceptable.

1. Manufacturers:

    a. Adams Rite (AD) – 4612 Series.
    b. Securitron (SU) - EL-EPT Series.

C. Electrified Quick Connect Data Transfer Hinges: Provide combined electrified power and Ethernet data transfer hinges with Molex™ standardized plug connectors to accommodate Electrified Quick Connect Data Transfer Hinges: Provide combined electrified power and Ethernet data transfer hinges with Molex™ standardized plug connectors to accommodate the electrified functions specified in the Door Hardware Sets. Connectors plug directly to through-door wiring harnesses for connection to electric locking devices and power supplies. Wire nut connections are not acceptable.

1. Data transfer hinges feature two 6-position and two 4-position Molex connectors, 9 multi-strand wires; 2 twisted pairs (26 AWG), 4 straight conductors (28 gauge) and 1 straight conductor (22 AWG) with concealed plug connectors eliminating the need for separate or exposed wiring. Rated 350 mA continuous @ 48 volts DC nominal, the hinge is capable of two PoE wiring configurations:

    a. Power over Data (5 wire): Power and Data supplied together over the 2 twisted 26 AWG) pairs. The 22 AWG conductor is used for the earth ground connection.
    b. Data with Power over Spares (9 wire): Data over 2 twisted (26 AWG) pairs with Power over spare pairs 94 straight 28 AWG conductors). The 22 Awg conductor is used for earth ground connection.

2. Manufacturers:

    a. Markar Products; ASSA ABLOY Architectural Door Accessories (MR) – PoE Series.

b. McKinney Products; ASSA ABLOY Architectural Door Accessories (MK) – PoE Series.
c. Pemko Products; ASSA ABLOY Architectural Door Accessories (PE) – PoE Series.

D. Electric Door Wire Harnesses: Provide electric/data transfer wiring harnesses with standardized plug connectors to accommodate up to twelve (12) wires. Connectors plug directly to through-door wiring harnesses for connection to electric locking devices and power supplies. Provide sufficient number and type of concealed wires to accommodate electric function of specified hardware. Provide a connector for through-door electronic locking devices and from hinge to junction box above the opening. Wire nut connections are not acceptable. Determine the length required for each electrified hardware component for the door type, size and construction, minimum of two per electrified opening.

1. Provide one each of the following tools as part of the base bid contract:
   a. McKinney Products; ASSA ABLOY Architectural Door Accessories (MK) - Electrical Connecting Kit: QC-R001.
   b. McKinney Products; ASSA ABLOY Architectural Door Accessories (MK) - Connector Hand Tool: QC-R003.

2. Manufacturers:

   a. Hager Companies (HA) - Quick Connect.
   b. McKinney Products; ASSA ABLOY Architectural Door Accessories (MK) – QC-C Series.
   c. Stanley Hardware (ST) – WH Series.

2.4 DOOR OPERATING TRIM

A. Flush Bolts and Surface Bolts: ANSI/BHMA A156.3 and A156.16, Grade 1, certified.

1. Flush bolts to be furnished with top rod of sufficient length to allow bolt retraction device location approximately six feet from the floor.
2. Furnish dust proof strikes for bottom bolts.
3. Surface bolts to be minimum 8” in length and U.L. listed for labeled fire doors and U.L. listed for windstorm components where applicable.
4. Provide related accessories (mounting brackets, strikes, coordinators, etc.) as required for appropriate installation and operation.

5. Manufacturers:

   a. Door Controls International (DC).
   b. Rockwood Products; ASSA ABLOY Architectural Door Accessories (RO).
   c. Trimco (TC).

B. Door Push Plates and Pulls: ANSI/BHMA A156.6 certified door pushes and pulls of type and design specified in the Hardware Sets. Coordinate and provide proper width and height as required where conflicting hardware dictates.

1. Push/Pull Plates: Minimum .050 inch thick, size as indicated in hardware sets, with beveled edges, secured with exposed screws unless otherwise indicated.
2. Door Pull and Push Bar Design: Size, shape, and material as indicated in the hardware sets. Minimum clearance of 2 1/2-inches from face of door unless otherwise indicated.
3. Offset Pull Design: Size, shape, and material as indicated in the hardware sets. Minimum clearance of 2 1/2-inches from face of door and offset of 90 degrees unless otherwise indicated.
4. Fasteners: Provide manufacturer's designated fastener type as indicated in Hardware Sets.

5. Manufacturers:

    a. Hiawatha, Inc. (HI).
    b. Rockwood Products; ASSA ABLOY Architectural Door Accessories (RO).
    c. Trimco (TC).

C. Locking Pull System: Post-mount style door pulls with integrated deadbolt locking system in type and design as specified in the Hardware Sets. Pulls available in multiple head, floor, or combination locking options, with outside keyed rim cylinder operation and inside turn piece activation. Mounting applications for aluminum, glass, steel and wood doors, with customized sizing and configuration options. Pull finishes include brass, bronze, and stainless steel.

1. Manufacturers:

    a. Blumcraft (BL) – Locking Ladder Series.
    b. Rockwood Products; ASSA ABLOY Architectural Door Accessories (RO) – LP Series.

2.5 CYLINDERS AND KEYING

A. General: Cylinder manufacturer to have minimum (10) years experience designing secured master key systems and have on record a published security keying system policy.

B. Source Limitations: Obtain each type of keyed cylinder and keys from the same source manufacturer as locksets and exit devices, unless otherwise indicated.

C. Cylinders: Original manufacturer cylinders complying with the following:

1. Mortise Type: Threaded cylinders with rings and cams to suit hardware application.
2. Rim Type: Cylinders with back plate, flat-type vertical or horizontal tailpiece, and raised trim ring.
3. Bored-Lock Type: Cylinders with tailpieces to suit locks.
4. Mortise and rim cylinder collars to be solid and recessed to allow the cylinder face to be flush and be free spinning with matching finishes.
5. Keyway: Manufacturer’s Standard.

D. Patented Cylinders: ANSI/BHMA A156.5, Grade 1, certified cylinders employing a utility patented and restricted keyway requiring the use of patented controlled keys. Provide bump resistant, fixed core cylinders as standard with solid recessed cylinder collars. Cylinders are to be factory keyed where permanent keying records will be established and maintained.

1. Provide a 6 pin multi-level master key system comprised of patented controlled keys and security and high security cylinders operated by one (1) key of the highest level. Geographical exclusivity to be provided for all security and high security cylinders and UL437 certification where specified.

    a. Level 1 Cylinders: Provide utility patented controlled keyway cylinders that are furnished with patented keys available only from authorized distribution.
    b. Level 2 Cylinders: Provide utility patented controlled keyway and side bar locking incorporating unique angled bottom pins for geographical exclusivity. Cylinders constructed to provide protection against bumping and picking.
    c. Level 3 Cylinders: Provide utility patented controlled keyway and side bar locking incorporating unique angled bottom pins for geographical exclusivity. Cylinders to be UL437 certified and constructed to provide protection against bumping, picking, and drilling.
    d. Refer to hardware sets for specified levels.

2. Manufacturers:
    a. Sargent Manufacturing (SA) - Degree Series.
    b. Corbin Russwin (RU) – Access 3 Series.

E. Keying System: Each type of lock and cylinders to be factory keyed.

1. Conduct specified "Keying Conference" to define and document keying system instructions and requirements.
2. Furnish factory cut, nickel-silver large bow permanently inscribed with a visual key control number as directed by Owner.
3. New System: Key locks to a new key system as directed by the Owner.

F. Key Quantity: Provide the following minimum number of keys:

1. Change Keys per Cylinder: Two (2)
2. Master Keys (per Master Key Level/Group): Five (5).

2.6 MECHANICAL LOCKS AND LATCHING DEVICES

A. Cylindrical Locksets, Grade 1 (Heavy Duty): ANSI/BHMA A156.2, Series 4000, Grade 1 certified.

1. Furnish with solid cast levers, standard 2 3/4” backset, and 1/2" (3/4" at rated paired openings) throw brass or stainless steel latchbolt.

2. Locks are to be non-handed and fully field reversible.

3. Extended cycle test: Locks to have been cycle tested in ordinance with ANSI/BHMA 156.2 requirements to 2 million cycles.

4. Manufacturers:

a. Corbin Russwin Hardware (RU) – CL3300 Series.
b. Sargent Manufacturing (SA) – 10 Line.
c. Stanley Best (BE) – 9K Series.

2.7 AUXILIARY LOCKS

A. Mortise Deadlocks, Large Case: ANSI/BHMA A156.13, Series 1000, Grade 1, certified large case mortise type deadlocks constructed of heavy gauge wrought corrosion resistant steel. One piece stainless steel bolts with a 1" throw. Deadlocks to be products of the same source manufacturer and keyway as other locksets.

1. Manufacturers:

a. Corbin Russwin Hardware (RU) - ML2000 Series.
b. Sargent Manufacturing (SA) - 8200 Series.
c. Stanley Best (BE) - 47H Series.

2.8 LOCK AND LATCH STRIKES

A. Strikes: Provide manufacturer's standard strike with strike box for each latch or lock bolt, with curved lip extended to protect frame, finished to match door hardware set, unless otherwise indicated, and as follows:

1. Flat-Lip Strikes: For locks with three-piece antifriction latchbolts, as recommended by manufacturer.
2. Extra-Long-Lip Strikes: For locks used on frames with applied wood casing trim.
3. Aluminum-Frame Strike Box: Provide manufacturer's special strike box fabricated for aluminum framing.
4. Double-lipped strikes: For locks at double acting doors. Furnish with retractable stop for rescue hardware applications.

B. Standards: Comply with the following:

1. Strikes for Mortise Locks and Latches: BHMA A156.13.
2. Strikes for Bored Locks and Latches: BHMA A156.2.
3. Strikes for Auxiliary Deadlocks: BHMA A156.36.
4. Dustproof Strikes: BHMA A156.16.

2.9 CONVENTIONAL EXIT DEVICES

A. General Requirements: All exit devices specified herein shall meet or exceed the following criteria:

1. At doors not requiring a fire rating, provide devices complying with NFPA 101 and listed and labeled for "Panic Hardware" according to UL305. Provide proper fasteners as required by manufacturer including sex nuts and bolts at openings specified in the Hardware Sets.

2. Where exit devices are required on fire rated doors, provide devices complying with NFPA 80 and with UL labeling indicating "Fire Exit Hardware". Provide devices with the proper fasteners for installation as tested and listed by UL. Consult manufacturer's catalog and template book for specific requirements.

3. Except on fire rated doors, provide exit devices with hex key dogging device to hold the pushbar and latch in a retracted position. Provide optional keyed cylinder dogging on devices where specified in Hardware Sets.

4. Devices must fit flat against the door face with no gap that permits unauthorized dogging of the push bar. The addition of filler strips is required in any case where the door light extends behind the device as in a full glass configuration.

5. Electromechanical Options: Subject to same compliance standards and requirements as mechanical exit devices, electrified devices to be of type and design as specified in hardware sets. Include any specific controllers when conventional power supplies are not sufficient to provide the proper inrush current.

6. Lever Operating Trim: Where exit devices require lever trim, furnish manufacturer's heavy duty escutcheon trim with threaded studs for thru-bolts.

    a. Lock Trim Design: As indicated in Hardware Sets, provide finishes and designs to match that of the specified locksets.
    b. Where function of exit device requires a cylinder, provide a cylinder (Rim or Mortise) as specified in Hardware Sets.

7. Vertical Rod Exit Devices: Where surface or concealed vertical rod exit devices are used at interior openings, provide as less bottom rod (LBR) unless otherwise indicated. Provide dust proof strikes where thermal pins are required to project into the floor.

8. Narrow Stile Applications: At doors constructed with narrow stiles, or as specified in Hardware Sets, provide devices designed for maximum 2" wide stiles.

9. Dummy Push Bar: Nonfunctioning push bar matching functional push bar.

10. Rail Sizing: Provide exit device rails factory sized for proper door width application.

11. Through Bolt Installation: For exit devices and trim as indicated in Door Hardware Sets.

B. Conventional Push Rail Exit Devices (Heavy Duty): ANSI/BHMA A156.3, Grade 1 certified panic and fire exit hardware devices furnished in the functions specified in the Hardware Sets. Exit device latch to be stainless steel, pullman type, with deadlock feature.

1. Manufacturers:

    a. Corbin Russwin Hardware (RU) - ED4000 / ED5000 Series.
    b. Sargent Manufacturing (SA) - 80 Series.

C. Extruded Aluminum Removable Mullions: ANSI/BHMA A156.3 anodized, removable mullions with malleable-iron top and bottom retainers. Mullions to be provided standard with stabilizers and imbedded weatherstrip.

1. Manufacturers:

a. Corbin Russwin Hardware (RU) – 808 Series.
b. Sargent Manufacturing (SA) - 980/980A Series.

2.10 DOOR CLOSERS

A. All door closers specified herein shall meet or exceed the following criteria:

1. General: Door closers to be from one manufacturer, matching in design and style, with the same type door preparations and templates regardless of application or spring size. Closers to be non-handed with full sized covers including installation and adjusting information on inside of cover.

2. Standards: Closers to comply with UL-10C for Positive Pressure Fire Test and be U.L. listed for use of fire rated doors.

3. Cycle Testing: Provide closers which have surpassed 15 million cycles in a test witnessed and verified by UL.

4. Size of Units: Comply with manufacturer's written recommendations for sizing of door closers depending on size of door, exposure to weather, and anticipated frequency of use. Where closers are indicated for doors required to be accessible to the physically handicapped, provide units complying with ANSI ICC/A117.1.

5. Closer Arms: Provide heavy duty, forged steel closer arms unless otherwise indicated in Hardware Sets.

6. Closers shall not be installed on exterior or corridor side of doors; where possible install closers on door for optimum aesthetics.

7. Closer Accessories: Provide door closer accessories including custom templates, special mounting brackets, spacers and drop plates as required for proper installation. Provide through-bolt and security type fasteners as specified in the hardware sets.

B. Door Closers, Surface Mounted (Commercial Duty): ANSI/BHMA 156.4, Grade 1 certified surface mounted, institutional grade door closers with complete spring power adjustment, sizes 1 thru 6; and fully operational adjustable according to door size, frequency of use, and opening force. Closers to be rack and pinion type, one piece cast iron or aluminum alloy body construction, with adjustable backcheck, closing sweep, and latch speed control valves. Provide non-handed units standard.

1. Manufacturers:

a. Corbin Russwin Hardware (RU) - DC6000 Series.

b. Dorma Products (DO) - 8900 Series.
c. Norton Door Controls (NO) - 8500 Series.
d. Sargent Manufacturing (SA) - 1431 Series.
e. Yale Locks and Hardware (YA) - 3500 Series.

2.11 DOOR STOPS AND HOLDERS

A. General: Door stops and holders to be of type and design as specified below or in the Hardware Sets.

B. Door Stops and Bumpers: ANSI/BHMA A156.16, Grade 1 certified door stops and wall bumpers. Provide wall bumpers, either convex or concave types with anchorage as indicated, unless floor or other types of door stops are specified in Hardware Sets. Do not mount floor stops where they will impede traffic. Where floor or wall bumpers are not appropriate, provide overhead type stops and holders.

1. Manufacturers:

a. Hiawatha, Inc. (HI).
b. Rockwood Products; ASSA ABLOY Architectural Door Accessories (RO).
c. Trimco (TC).

2.12 ARCHITECTURAL SEALS

A. General: Thresholds, weatherstripping, and gasket seals to be of type and design as specified below or in the Hardware Sets. Provide continuous weatherstrip gasketing on exterior doors and provide smoke, light, or sound gasketing on interior doors where indicated. At exterior applications provide non-corrosive fasteners and elsewhere where indicated.

B. Smoke Labeled Gasketing: Assemblies complying with NFPA 105 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for smoke control ratings indicated, based on testing according to UL 1784.

1. Provide smoke labeled perimeter gasketing at all smoke labeled openings.

C. Fire Labeled Gasketing: Assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to UL-10C.

1. Provide intumescent seals as indicated to meet UL10C Standard for Positive Pressure Fire Tests of Door Assemblies, and NPFA 252, Standard Methods of Fire Tests of Door Assemblies.

D. Sound-Rated Gasketing: Assemblies that are listed and labeled by a testing and inspecting agency, for sound ratings indicated.

E. Replaceable Seal Strips: Provide only those units where resilient or flexible seal strips are easily replaceable and readily available from stocks maintained by manufacturer.

F. Manufacturers:

1. National Guard Products (NG).
2. Pemko Products; ASSA ABLOY Architectural Door Accessories (PE).
3. Reese Enterprises, Inc. (RE).

2.13 FABRICATION

A. Fasteners: Provide door hardware manufactured to comply with published templates generally prepared for machine, wood, and sheet metal screws. Provide screws according to manufacturers recognized installation standards for application intended.

2.14 FINISHES

A. Standard: Designations used in the Hardware Sets and elsewhere indicate hardware finishes complying with ANSI/BHMA A156.18, including coordination with traditional U.S. finishes indicated by certain manufacturers for their products.

B. Provide quality of finish, including thickness of plating or coating (if any), composition, hardness, and other qualities complying with manufacturer's standards, but in no case less than specified by referenced standards for the applicable units of hardware

C. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine scheduled openings, with Installer present, for compliance with requirements for installation tolerances, labeled fire door assembly construction, wall and floor construction, and other conditions affecting performance.

B. Notify architect of any discrepancies or conflicts between the door schedule, door types, drawings and scheduled hardware. Proceed only after such discrepancies or conflicts have been resolved in writing.

3.2 PREPARATION

A. Hollow Metal Doors and Frames: Comply with ANSI/DHI A115 series.

B. Wood Doors: Comply with ANSI/DHI A115-W series.

3.3 INSTALLATION

A. Install each item of mechanical and electromechanical hardware and access control equipment to comply with manufacturer's written instructions and according to specifications.

1. Installers are to be trained and certified by the manufacturer on the proper installation and adjustment of fire, life safety, and security products including: hanging devices; locking devices; closing devices; and seals.

B. Mounting Heights: Mount door hardware units at heights indicated in following applicable publications, unless specifically indicated or required to comply with governing regulations:

1. Standard Steel Doors and Frames: DHI's "Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames."
2. Wood Doors: DHI WDHS.3, "Recommended Locations for Architectural Hardware for Wood Flush Doors."
3. Where indicated to comply with accessibility requirements, comply with ANSI A117.1 "Accessibility Guidelines for Buildings and Facilities."
4. Provide blocking in drywall partitions where wall stops or other wall mounted hardware is located.

C. Retrofitting: Install door hardware to comply with manufacturer's published templates and 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 specified in Division 9 Sections. Do not install surface-mounted items until finishes have been completed on substrates involved.

D. Thresholds: Set thresholds for exterior and acoustical doors in full bed of sealant complying with requirements specified in Division 7 Section "Joint Sealants."

E. Storage: Provide a secure lock up for hardware delivered to the project but not yet installed. Control the handling and installation of hardware items so that the completion of the work will not be delayed by hardware losses before and after installation.

3.4 FIELD QUALITY CONTROL

A. Field Inspection: Supplier will perform a final inspection of installed door hardware and state in report whether work complies with or deviates from requirements, including whether door hardware is properly installed, operating 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.

3.6 CLEANING AND PROTECTION

A. Protect all hardware stored on construction site in a covered and dry place. Protect exposed hardware installed on doors during the construction phase. Install any and all hardware at the latest possible time frame.

B. Clean adjacent surfaces soiled by door hardware installation.

C. Clean operating items as necessary to restore proper finish. Provide final protection and maintain conditions that ensure door hardware is without damage or deterioration at time of owner occupancy.

3.7 DEMONSTRATION

A. Instruct Owner's maintenance personnel to adjust, operate, and maintain mechanical and electromechanical door hardware.

3.8 DOOR HARDWARE SETS

A. The hardware sets represent the design intent and direction of the owner and architect. They are a guideline only and should not be considered a detailed hardware schedule. Discrepancies, conflicting hardware and missing items should be brought to the attention of the architect with corrections made prior to the bidding process. Omitted items not included in a hardware set should be scheduled with the appropriate additional hardware required for proper application and functionality.

B. The supplier is responsible for handing and sizing all products and providing the correct option for the appropriate door type and material where more than one is presented in the hardware sets. Quantities listed are for each pair of doors, or for each single door.

C. Manufacturer’s Abbreviations:

1. MK - McKinney
2. PE - Pemko
3. RO - Rockwood
4. RU - Corbin Russwin
5. AD - Adams Rite
6. HD - HID
7. SU - Securitron

Hardware Sets

Set: 1.0

Doors: 101A

2	Continuous Hinge	CFM HD1		PE
1	Removable Mullion	808 M57	628	RU
1	Exit Device (rim, exit only)	ED4200 EO M110 M58 M52 M57 CRA1 CMK	630	RU
1	Exit Device (rim, nightlatch)	ED4200 K157 x 6P M110 M58 M52 M57 CRA1 CMK	630	RU
2	Door Pull	BF157 Mtg-Type 12HD	US32D	RO
2	Surface Closer	DC6220 A11 HDTJSA M54	689	RU
1	Threshold	271A		PE
2	Door Sweep	315CN		PE
1	Gasketing	Provided by Frame Manufacturer		

Set: 2.0

Doors: 209

2	Continuous Hinge	CFM HD1		PE
2	Flush Bolt	555 (12"-24" as required)	US26D	RO
1	Mortise Deadlock	MS1850SN	628	AD
1	Thumb Turn Cylinder	4066	130	AD
2	Push Bar & Pull	BF15747	US32D	RO
2	Surface Closer	DC6220 A11 HDTJSA M54	689	RU
2	Door Stop	466-RKW	Black	RO
1	Threshold	271A		PE
2	Door Sweep	315CN		PE
1	Gasketing	Provided by Frame Manufacturer		

Set: 3.0

Doors: ST-2A

1	Electric Hinge	T4A3786 PoE	US26D	MK ⚡
2	Hinge	T4A3786 x NRP	US26D	MK
1	Access Control Exit Device Rim Exit	ED5200N IN220 IPS MB N9134ET M110 AP CMK (Section 281300)	630	RU ⚡
1	Surface Closer	DC6210 A3 HDPA M54	689	RU
1	Door Stop	466-RKW	Black	RO
1	Threshold	271A		PE
1	Door Sweep	315CN		PE
1	Gasketing	305CR		PE

1	Frame Harness	PoE-CXXXRJ (provided by 281300)		MK ⚡
1	Door Harness	PoE-CXXXRJ (provided by 281300)		MK ⚡

Notes: Electronic Access Control Opening: Supply, commission, test and termination of access control system by Security Integrator - Section 281300.
Normal state of door is closed and locked. Access from secure side is obtained by presenting a valid credential to the integrated card reader. Access control lock will be released for 5 to 7 seconds and relock automatically. Key override by security cylinder only.
Free egress at all time.

Set: 4.0

Doors: C01A

1	Electric Hinge	T4A3786 PoE	US26D	MK ⚡
2	Hinge	T4A3786 x NRP	US26D	MK
1	Access Control Exit Device Rim Exit	ED5200N IN220 IPS MB N9134ET M110 AP CMK (Section 281300)	630	RU ⚡
1	Surface Closer	DC6210 A3 HDPA M54	689	RU
1	Door Stop	466-RKW	Black	RO
1	Acoustic Threshold	2008APK		PE
1	Sound Gasketing	312CR		PE
1	Sound Gasketing	S44BL		PE
1	Acoustic Corner Pad	ACP112BL/2		PE
1	Acoustic Door Bottom	3692APK773BL		PE
1	Frame Harness	PoE-CXXXRJ (provided by 281300)		MK ⚡
1	Door Harness	PoE-CXXXRJ (provided by 281300)		MK ⚡

Notes: Electronic Access Control Opening: Supply, commission, test and termination of access control system by Security Integrator - Section 281300.
Normal state of door is closed and locked. Access from secure side is obtained by presenting a valid credential to the integrated card reader. Access control lock will be released for 5 to 7 seconds and relock automatically. Key override by security cylinder only.
Free egress at all time.

Set: 5.0

Doors: C01B

3	Hinge	T4A3786 x NRP	US26D	MK
1	Exit Device (rim, exit only)	ED5200 EO M110	630	RU
1	Surface Closer	DC6210 A3 HDPA M54	689	RU
1	Door Stop	466-RKW	Black	RO
1	Acoustic Threshold	2008APK		PE

1	Sound Gasketing	312CR		PE
1	Sound Gasketing	S44BL		PE
1	Acoustic Corner Pad	ACP112BL/2		PE
1	Acoustic Door Bottom	3692APK773BL		PE

Set: 6.0

Doors: 126A

1	Electric Hinge	T4A3786 PoE	US26D	MK ⚡
2	Hinge	T4A3786 x NRP	US26D	MK
1	Access Control Cyl Lock	IN220-CL33134 IPS NZD AP CMK (Section 281300)	626	RU ⚡
1	Surface Closer	DC6210 A3 HDPA M54	689	RU
1	Door Stop	466-RKW	Black	RO
1	Threshold	271A		PE
1	Door Sweep	315CN		PE
1	Rain Guard	346C		PE
1	Gasketing	305CR		PE
1	Frame Harness	PoE-CXXXRJ (provided by 281300)		MK ⚡
1	Door Harness	PoE-CXXXRJ (provided by 281300)		MK ⚡

Notes: Electronic Access Control Opening: Supply, commission, test and termination of access control system by Security Integrator - Section 281300.
Normal state of door is closed and locked. Access from secure side is obtained by presenting a valid credential to the integrated card reader. Access control lock will be released for 5 to 7 seconds and relock automatically. Key override by security cylinder only.
Free egress at all time.

Set: 7.0

Doors: 130, 146

1	Electric Hinge	T4A3786 PoE	US26D	MK ⚡
2	Hinge	T4A3786 x NRP	US26D	MK
1	Access Control Cyl Lock	IN220-CL33134 IPS NZD AP CMK (Section 281300)	626	RU ⚡
1	Surface Closer	DC6210 A11 HDSA M54	689	RU
1	Threshold	271A		PE
1	Door Sweep	315CN		PE
1	Gasketing	305CR		PE
1	Frame Harness	PoE-CXXXRJ (provided by 281300)		MK ⚡
1	Door Harness	PoE-CXXXRJ (provided by 281300)		MK ⚡

Notes: Electronic Access Control Opening: Supply, commission, test and termination of access control system by Security Integrator - Section 281300.
Normal state of door is closed and locked. Access from secure side is obtained by presenting a valid credential to the integrated card reader. Access control lock will be released for 5 to 7 seconds and relock automatically. Key override by security cylinder only.
Free egress at all time.

Set: 8.0

Doors: 126B, 137, 139, 150A

1	Electric Hinge	T4A3786 PoE	US26D	MK ⚡
2	Hinge	T4A3786	US26D	MK
1	Access Control Cyl Lock	IN220-CL33134 IPS NZD AP CMK (Section 281300)	626	RU ⚡
1	Surface Closer	DC6200 RA M54	689	RU
1	Stop	406/409/481 (as required)	US32D	RO
1	Threshold	271A		PE
1	Door Sweep	315CN		PE
1	Gasketing	305CR		PE
1	Frame Harness	PoE-CXXXRJ (provided by 281300)		MK ⚡
1	Door Harness	PoE-CXXXRJ (provided by 281300)		MK ⚡

Notes: Electronic Access Control Opening: Supply, commission, test and termination of access control system by Security Integrator - Section 281300.
Normal state of door is closed and locked. Access from secure side is obtained by presenting a valid credential to the integrated card reader. Access control lock will be released for 5 to 7 seconds and relock automatically. Key override by security cylinder only.
Free egress at all time.

Set: 9.0

Doors: 138A, 138B

3	Hinge	T4A3786 x NRP	US26D	MK
1	Storeroom Lock	CL3357 NZD CRA1 CMK	626	RU
1	Surface Closer	DC6210 A3 HDPA M54	689	RU
1	Door Stop	466-RKW	Black	RO
1	Threshold	271A		PE
1	Door Sweep	315CN		PE
1	Rain Guard	346C		PE
1	Gasketing	305CR		PE
1	Latch Protector	325	US26D	RO

Set: 10.0

Doors: 123

3	Hinge	T4A3786	US26D	MK
1	Storeroom Lock	CL3357 NZD CRA1 CMK	626	RU
1	Surface Closer	DC6200 RA M54	689	RU
1	Stop	406/409/481 (as required)	US32D	RO
1	Threshold	271A		PE
1	Door Sweep	315CN		PE
1	Rain Guard	346C		PE
1	Gasketing	305CR		PE

Set: 11.0

Doors: 101B

1	Electric Continuous Hinge	CFM HD1 SER		PE ⚡
1	Electric Transfer Continuous Hinge	CFM HD1 PT EL-EPT		PE ⚡
1	Removable Mullion	808 M57	628	RU
1	Exit Device (rim, exit only)	ED5200 EO M110 M91 M51	630	RU ⚡
1	Access Control Exit Device Rim Exit	ED5200N IN220 IPS MB N9134ET M110 AP CMK (Section 281300)	630	RU ⚡
2	Surface Closer	DC6220 A11 HDTJSA M54	689	RU
1	Sound Gasketing	312CR		PE
1	Sound Gasketing	S44BL		PE
1	Acoustic Corner Pad	ACP112BL/2		PE
2	Acoustic Door Bottom	3692APK773BL		PE
1	Frame Harness	QC-C1500P (as required) (Section 281300)		MK ⚡
1	Door Harness	QC-C__ (as required) (Section 281300)		MK ⚡
1	Frame Harness	PoE-CXXXRJ (provided by 281300)		MK ⚡
1	Door Harness	PoE-CXXXRJ (provided by 281300)		MK ⚡

Notes: Electronic Access Control Opening: Supply, commission, test and termination of access control system by Security Integrator - Section 281300.
Normal state of door is closed and locked. Access from secure side is obtained by presenting a valid credential to the integrated card reader. Access control lock will be released for 5 to 7 seconds and relock automatically. Key override by security cylinder only.
Free egress at all time.

Set: 12.0

Doors: 201

1	Electric Transfer Continuous Hinge	CFM HD1 PT EL-EPT		PE ⚡
1	Access Control Exit Device Rim Exit	ED5200N IN220 IPS MB N9134ET M110 AP CMK (Section 281300)	630	RU ⚡
1	Surface Closer	DC6220 A11 HDTJSA M54	689	RU
1	Stop	406/409/481 (as required)	US32D	RO
1	Frame Harness	PoE-CXXXRJ (provided by 281300)		MK ⚡
1	Door Harness	PoE-CXXXRJ (provided by 281300)		MK ⚡

Notes: Electronic Access Control Opening: Supply, commission, test and termination of access control system by Security Integrator - Section 281300.
Normal state of door is closed and locked. Access from secure side is obtained by presenting a valid credential to the integrated card reader. Access control lock will be released for 5 to 7 seconds and relock automatically. Key override by security cylinder only.
Free egress at all time.

Set: 13.0

Doors: 114

1	Continuous Hinge	CFM HD1		PE
1	Exit Device (rim, nightlatch)	ED4200 K157 x 6P M110 M58 M52 CRA1 CMK	630	RU
1	Door Pull	BF157 Mtg-Type 12HD	US32D	RO
1	Surface Closer	DC6220 A11 HDTJSA M54	689	RU
1	Stop	406/409/481 (as required)	US32D	RO
1	Sound Gasketing	312CR		PE
1	Sound Gasketing	S44BL		PE
1	Acoustic Corner Pad	ACP112BL/2		PE
1	Acoustic Door Bottom	3692APK773BL		PE

Set: 14.0

Doors: ST-2B

3	Hinge	T4A3786	US26D	MK
1	Exit Device (rim, passage)	ED5200 N910 M110	630	RU
1	Surface Closer	DC6200 RA M54	689	RU
1	Stop	406/409/481 (as required)	US32D	RO
1	Acoustic Threshold	2008APK		PE
1	Sound Gasketing	312CR		PE

1	Sound Gasketing	S44BL		PE
1	Acoustic Corner Pad	ACP112BL/2		PE
1	Acoustic Door Bottom	3692APK773BL		PE

Set: 15.0

Doors: 104, 115, 117, 202, 214

1	Electric Hinge	T4A3786 PoE	US26D	MK ⚡
2	Hinge	T4A3786 x NRP	US26D	MK
1	Access Control Cyl Lock	IN220-CL33134 IPS NZD AP CMK (Section 281300)	626	RU ⚡
1	Surface Closer	DC6200 RA M54	689	RU
1	Stop	406/409/481 (as required)	US32D	RO
1	Sound Gasketing	312CR		PE
1	Sound Gasketing	S44BL		PE
1	Acoustic Corner Pad	ACP112BL/2		PE
1	Acoustic Door Bottom	3692APK773BL		PE
1	Frame Harness	PoE-CXXXRJ (provided by 281300)		MK ⚡
1	Door Harness	PoE-CXXXRJ (provided by 281300)		MK ⚡

Notes: Electronic Access Control Opening: Supply, commission, test and termination of access control system by Security Integrator - Section 281300.
Normal state of door is closed and locked. Access from secure side is obtained by presenting a valid credential to the integrated card reader. Access control lock will be released for 5 to 7 seconds and relock automatically. Key override by security cylinder only.
Free egress at all time.

Set: 16.0

Doors: 215A, 215B, 228

2	Hinge	TA2714 x NRP	US26D	MK
1	Electric Hinge	TA2714 PoE	US26D	MK ⚡
1	Access Control Cyl Lock	IN220-CL33134 IPS NZD AP CMK (Section 281300)	626	RU ⚡
1	Surface Closer	DC6210 A3 HDPA M54	689	RU
1	Stop	406/409/481 (as required)	US32D	RO
1	Sound Gasketing	312CR		PE
1	Sound Gasketing	S44BL		PE
1	Acoustic Corner Pad	ACP112BL/2		PE
1	Acoustic Door Bottom	3692APK773BL		PE
1	Frame Harness	PoE-CXXXRJ (provided by 281300)		MK ⚡

1	Door Harness	PoE-CXXXRJ (provided by 281300)		MK ⚡

Notes: Electronic Access Control Opening: Supply, commission, test and termination of access control system by Security Integrator - Section 281300.
Normal state of door is closed and locked. Access from secure side is obtained by presenting a valid credential to the integrated card reader. Access control lock will be released for 5 to 7 seconds and relock automatically. Key override by security cylinder only.
Free egress at all time.

Set: 17.0

Doors: 131B, 133B, 135, 141, 143B, 144B, 206, 216, 217A

1	Electric Hinge	T4A3786 PoE	US26D	MK ⚡
2	Hinge	TA2714	US26D	MK
1	Access Control Cyl Lock	IN220-CL33134 IPS NZD AP CMK (Section 281300)	626	RU ⚡
1	Surface Closer	DC6200 RA M54	689	RU
1	Stop	406/409/481 (as required)	US32D	RO
3	Silencer	608		RO
1	Frame Harness	PoE-CXXXRJ (provided by 281300)		MK ⚡
1	Door Harness	PoE-CXXXRJ (provided by 281300)		MK ⚡

Notes: Electronic Access Control Opening: Supply, commission, test and termination of access control system by Security Integrator - Section 281300.
Normal state of door is closed and locked. Access from secure side is obtained by presenting a valid credential to the integrated card reader. Access control lock will be released for 5 to 7 seconds and relock automatically. Key override by security cylinder only.
Free egress at all time.

Set: 17.1

Doors: 129, 145, 149a, 149b, 205, 210, 211, 222, 223, 224, 225

1	Electric Hinge	T4A3786 PoE	US26D	MK ⚡
2	Hinge	TA2714	US26D	MK
1	Access Control Cyl Lock	IN220-CL33134 IPS NZD AP CMK (Section 281300)	626	RU ⚡
1	Surface Closer	DC6200 RA M54	689	RU
1	Stop	406/409/481 (as required)	US32D	RO
1	Sound Gasketing	312CR		PE
1	Sound Gasketing	S44BL		PE
1	Acoustic Corner Pad	ACP112BL/2		PE
1	Acoustic Door Bottom	3692APK773BL		PE

1	Frame Harness	PoE-CXXXRJ (provided by 281300)		MK ⚡
1	Door Harness	PoE-CXXXRJ (provided by 281300)		MK ⚡

Notes: Electronic Access Control Opening: Supply, commission, test and termination of access control system by Security Integrator - Section 281300.
Normal state of door is closed and locked. Access from secure side is obtained by presenting a valid credential to the integrated card reader. Access control lock will be released for 5 to 7 seconds and relock automatically. Key override by security cylinder only.
Free egress at all time.

Set: 18.0

Doors: 110, 134, 142, EL-1

3	Hinge	TA2714 x NRP	US26D	MK
1	Storeroom Lock	CL3357 NZD CRA1 CMK	626	RU
1	Surface Closer	DC6210 A11 HDSA M54	689	RU
3	Silencer	608		RO

Set: 19.0

Doors: 116, 124, 125, 151, 152, 153, 207, 218, 219

3	Hinge	TA2714	US26D	MK
1	Storeroom Lock	CL3357 NZD CRA1 CMK	626	RU
1	Surface Closer	DC6200 RA M54	689	RU
1	Stop	406/409/481 (as required)	US32D	RO
3	Silencer	608		RO

Set: 20.0

Doors: 204

3	Hinge	TA2714	US26D	MK
1	Privacy Set	CL3320 NZD	626	RU
1	Surface Closer	DC6200 RA M54	689	RU
1	Stop	406/409/481 (as required)	US32D	RO
1	Gasketing	S773BL		PE

Set: 21.0

Doors: 127, 128, 147, 148

3	Hinge	TA2714	US26D	MK
1	Passage Set	CL3310 NZD	626	RU

1	Surface Closer	DC6200 RA M54	689	RU
1	Stop	406/409/481 (as required)	US32D	RO
1	Sound Gasketing	312CR		PE
1	Sound Gasketing	S44BL		PE
1	Acoustic Corner Pad	ACP112BL/2		PE
1	Acoustic Door Bottom	3692APK773BL		PE

Set: 22.0

Doors: 111, 112, 131A, 133A, 143A, 144A, 208, 220, 221

3	Hinge	TA2714	US26D	MK
1	Push Plate	70F	US32D	RO
1	Pull Plate	BF 111x70C	US32D	RO
1	Surface Closer	DC6200 RA M54	689	RU
1	Stop	406/409/481 (as required)	US32D	RO
1	Sound Gasketing	312CR		PE
1	Sound Gasketing	S44BL		PE
1	Acoustic Corner Pad	ACP112BL/2		PE
1	Acoustic Door Bottom	3692APK773BL		PE

Set: 22.1

Doors: 229, 230

3	Hinge	TA2714	US26D	MK
1	Push Plate	70F	US32D	RO
1	Pull Plate	BF 111x70C	US32D	RO
1	Surface Closer	DC6200 RA M54	689	RU
1	Stop	406/409/481 (as required)	US32D	RO
1	Gasketing	S773BL		PE

Set: 23.0

Doors: 217B

3	Hinge	TA2714	US26D	MK
1	Classroom Lock	CL3355 NZD CRA1 CMK	626	RU
1	Stop	406/409/481 (as required)	US32D	RO
3	Silencer	608		RO

Set: 23.1

Doors: 113

3	Hinge	TA2714	US26D	MK
1	Classroom Lock	CL3355 NZD CRA1 CMK	626	RU
1	Stop	406/409/481 (as required)	US32D	RO
1	Sound Gasketing	312CR		PE
1	Sound Gasketing	S44BL		PE
1	Acoustic Corner Pad	ACP112BL/2		PE
1	Acoustic Door Bottom	3692APK773BL		PE

Set: 24.0

Doors: 102, 103, 108, 109, 119, 120

3	Hinge	TA2714	US26D	MK
1	Entrance Lock	CL3351 NZD CRA1 CMK	626	RU
1	Stop	406/409/481 (as required)	US32D	RO
1	Sound Gasketing	312CR		PE
1	Sound Gasketing	S44BL		PE
1	Acoustic Corner Pad	ACP112BL/2		PE
1	Acoustic Door Bottom	3692APK773BL		PE

Set: 25.0

Doors: 127A, 127B, 127C, 128A, 128B, 128C, 147A, 147B, 147C, 148A, 148B, 148C

1	Sliding Pocket Door Track & Hdwe	PF28200A		PE
1	Dust Proof Strike	570	US26D	RO
1	Rim Cylinder	3000-CRA1 CMK	626	RU
1	Locking Pull	LP3301DBD ADA LC	US32D	RO
1	Pocket Door Gasketing	35041CSB (install on frame at both sides of door, lead and top edges)		PE
1	Acoustic Door Bottom	3692APK773BL		PE

Set: 26.0

Doors: 126C, 138C, 138D, 138E, 138F, 150B, 301

1	Hardware	Provided by Door Manufacturer

Notes: All hardware to be provided by Door Manufacturer

Set: 27.0

200 Crendential	Card (Section 281300)	HD

Notes: Provide the above material as part of the Electronic Access Control system as part of Specification Section 281300.

END OF SECTION 087100

SECTION 08 8000 - GLAZING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Insulating glass units.

B. Glazing units.

C. Glazing compounds and accessories.

1.02 RELATED REQUIREMENTS

A. Section 07 9200 - Joint Sealants: Sealants for other than glazing purposes.

B. Section 08 1113 - Hollow Metal Doors and Frames: Glazed lites in doors and borrowed lites.

C. Section 08 1416 - Flush Wood Doors: Glazed lites in doors.

D. Section 08 4229 - Automatic Entrances: Glazing furnished as part of door assembly.

E. Section 08 4313 - Aluminum-Framed Storefronts: Glazing furnished as part of storefront assembly.

F. Section 08 4413 - Glazed Aluminum Curtain Walls: Glazing furnished as part of wall assembly.

G. Section 08 5113 - Aluminum Windows: Glazing furnished by window manufacturer.

H. Section 08 6300 - Metal-Framed Skylights: Glazing furnished as part of skylights assembly.

I. Section 08 8300 - Mirrors.

J. Section 13 4913 - Integrated X-Ray Shielding Assemblies: Leaded glass.

1.03 REFERENCE STANDARDS

A. 16 CFR 1201 - Safety Standard for Architectural Glazing Materials; current edition.

B. ANSI Z97.1 - American National Standard for Safety Glazing Materials Used in Buildings - Safety Performance Specifications and Methods of Test; 2015.

C. ASCE 7 - Minimum Design Loads for Buildings and Other Structures; 2010, with 2013 Supplements and Errata.

D. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2014a.

E. ASTM C1036 - Standard Specification for Flat Glass; 2016.

F. ASTM C1048 - Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass; 2012.

G. ASTM C1172 - Standard Specification for Laminated Architectural Flat Glass; 2014.

H. ASTM C1193 - Standard Guide for Use of Joint Sealants; 2016.

I. ASTM E1300 - Standard Practice for Determining Load Resistance of Glass in Buildings; 2012a.

J. GANA (GM) - GANA Glazing Manual; 2009.

K. GANA (SM) - GANA Sealant Manual; 2008.

L. GANA (LGRM) - Laminated Glazing Reference Manual; 2009.

M. ICC (IBC) - International Building Code; 2015.

N. IGMA TM-3000 - North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial & Residential Use; 1990 (2004).

O. NFRC 100 - Procedure for Determining Fenestration Product U-factors; 2014.

P. NFRC 200 - Procedure for Determining Fenestration Product Solar Heat Gain Coefficient and Visible Transmittance at Normal Incidence; 2014.

Q. NFRC 300 - Test Method for Determining the Solar Optical Properties of Glazing Materials and Systems; 2014.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Convene a preinstallation meeting one week before starting work of this section; require attendance by each of the affected installers.

1.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data on Insulating Glass Unit and Glazing Unit Glazing Types: Provide structural, physical and environmental characteristics, size limitations, special handling and installation requirements.

C. Samples: Submit two samples 12 by 12 inch in size of glass units.

D. Certificate: Certify that products of this section meet or exceed specified requirements.

E. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 01 6000 - Product Requirements, for additional provisions.
   2. Extra Insulating Glass Units: One of each glass size and each glass type.

1.06 QUALITY ASSURANCE

A. Perform Work in accordance with GANA (GM), GANA (SM), GANA (LGRM), and IGMA TM-3000 for glazing installation methods. Maintain one copy on site.

B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years of documented experience.

C. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years documented experience.

D. Testing Agency Qualifications: Independent firm specializing in performing testing and inspections of the type specified in this section.

1.07 FIELD CONDITIONS

A. Do not install glazing when ambient temperature is less than 40 degrees F.

B. Maintain minimum ambient temperature before, during and 24 hours after installation of glazing compounds.

1.08 WARRANTY

A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.

B. Insulating Glass Units: Provide a five (5) year manufacturer warranty to include coverage for seal failure, interpane dusting or misting, including providing products to replace failed units.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Float Glass Manufacturers:
1. PPG Industries, Inc: www.ppgideascapes.com.
2. AGC Glass Company North America, Inc: www.us.agc.com.
3. Cardinal Glass Industries: www.cardinalcorp.com.
4. Guardian Industries Corp: www.sunguardglass.com.
5. Pilkington North America Inc: www.pilkington.com/na.
6. Substitutions: Refer to Section 01 6000 - Product Requirements.

B. Laminated Glass Manufacturers:
1. Cardinal Glass Industries: www.cardinalcorp.com.
2. Viracon, Architectural Glass segment of Apogee Enterprises, Inc: www.viracon.com.
3. Substitutions: Refer to Section 01 6000 - Product Requirements.

C. Radiation Shielding Glass Manufacturers:
1. Corning Inc; Med-X: www.mcgrory.com/#sle.
2. SCHOTT North America Inc: www.us.schott.com.
3. Substitutions: Refer to Section 01 6000 - Product Requirements.

2.02 PERFORMANCE REQUIREMENTS - EXTERIOR GLAZING ASSEMBLIES

A. Provide type and thickness of exterior glazing assemblies to support assembly dead loads, and to withstand live loads caused by positive and negative wind pressure acting normal to plane of glass.
   1. Design Pressure: Calculated in accordance with ASCE 7.
   2. Comply with ASTM E1300 for design load resistance of glass type, thickness, dimensions, and maximum lateral deflection of supported glass.
   3. Seismic Loads: Design and size glazing components to withstand seismic loads and sway displacement in accordance with the requirements of ASCE 7.
   4. Provide glass edge support system sufficiently stiff to limit the lateral deflection of supported glass edges to less than 1/175 of their lengths under specified design load.
   5. Glass thicknesses listed are minimum.

B. Vapor Retarder and Air Barrier Seals: Provide completed assemblies that maintain continuity of building enclosure vapor retarder and air barrier.
   1. In conjunction with vapor retarder and joint sealer materials described in other sections.

C. Thermal and Optical Performance: Provide exterior glazing products with performance properties as indicated. Performance properties are in accordance with manufacturer's published data as determined with the following procedures and/or test methods:
   1. Center of Glass U-Value: Comply with NFRC 100 using Lawrence Berkeley National Laboratory (LBNL) WINDOW 6.3 computer program.
   2. Center of Glass Solar Heat Gain Coefficient (SHGC): Comply with NFRC 200 using Lawrence Berkeley National Laboratory (LBNL) WINDOW 6.3 computer program.
   3. Solar Optical Properties: Comply with NFRC 300 test method.

2.03 GLASS MATERIALS

A. Float Glass: Provide float glass based glazing unless otherwise indicated.
   1. Annealed Type: ASTM C1036, Type I - Transparent Flat, Class 1 - Clear, Quality - Q3.
   2. Kind HS - Heat-Strengthened Type: Complies with ASTM C1048.
   3. Tinted Type: ASTM C1036, Class 2 - Tinted, Quality-Q3, color and performance characteristics equivelant to SOLARBAN 70XL, tint to be selected from manufacturers full range of colors.

B. Laminated Glass: Float glass laminated in accordance with ASTM C1172.
   1. Laminated Safety Glass: Complies with ANSI Z97.1 - Class B or 16 CFR 1201 - Category I impact test requirements.

2.04 BASIS OF DESIGN - INSULATING GLASS UNITS

A. Basis of Design - Insulating Glass Units: Vision glazing, with Low-E coating.
   1. Applications: Exterior insulating glass glazing unless otherwise indicated.
   2. Space between lites filled with air.
   3. Total Thickness: 1 inch.
   4. Thermal Transmittance (U-Value), Summer - Center of Glass:.26, nominal.
   5. Visible Light Transmittance (VLT): 51 percent, nominal.

6. Solar Heat Gain Coefficient (SHGC):.24, nominal.
7. Visible Light Reflectance, Outside: 9 percent, nominal.
8. Spacer Color: Black.
9. Edge Seal:
10. Color: Black.
11. Purge interpane space with dry air, hermetically sealed.
12. Basis of Design - Vitro Architectural Glass (formerly PPG Glass): www.vitroglazings.com/#sle.
13. Outboard Lite: Annealed float glass, 1/4 inch thick, minimum.
    a. Low-E Coating: Vitro Architectural Glass (formerly PPG Glass) Solarban 70XL on #2 surface.
    b. Glass Tint: Atlantica (light green).
14. Inboard Lite: Heat-strengthened float glass, 1/4 inch thick.
    a. Coating: No coating on inboard lite.

2.05 SOURCE QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements, for additional requirements.

B. Provide shop inspection and testing for Type IG-1 glass.

PART 3 EXECUTION

3.01 VERIFICATION OF CONDITIONS

A. Verify that openings for glazing are correctly sized and within tolerances, including those for size, squareness, and offsets at corners.

B. Verify that surfaces of glazing channels or recesses are clean, free of obstructions that may impede moisture movement, weeps are clear, and support framing is ready to receive glazing system.

3.02 PREPARATION

A. Clean contact surfaces with appropriate solvent and wipe dry within maximum of 24 hours before glazing. Remove coatings that are not tightly bonded to substrates.

B. Seal porous glazing channels or recesses with substrate compatible primer or sealer.

C. Prime surfaces scheduled to receive sealant where required for proper sealant adhesion.

3.03 INSTALLATION, GENERAL

END OF SECTION

SECTION 09 2116 - GYPSUM BOARD ASSEMBLIES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Performance criteria for gypsum board assemblies.

B. Metal stud wall framing.

C. Metal channel ceiling framing.

D. Acoustic insulation.

E. Gypsum sheathing.

F. Cementitious backing board.

G. Gypsum wallboard.

H. Joint treatment and accessories.

I. Textured finish system.

J. Water-resistive barrier over exterior wall sheathing.

1.02 RELATED REQUIREMENTS

A. Section 05 4000 - Cold-Formed Metal Framing: Exterior wind-load-bearing metal stud framing.

B. Section 06 1000 - Rough Carpentry: Building framing and sheathing.

C. Section 06 1000 - Rough Carpentry: Wood blocking product and execution requirements.

D. Section 07 2100 - Thermal Insulation: Acoustic insulation.

E. Section 07 2500 - Weather Barriers: Water-resistive barrier over sheathing.

F. Section 07 8400 - Firestopping: Top-of-wall assemblies at fire rated walls.

G. Section 09 2216 - Non-Structural Metal Framing.

H. Section 09 3000 - Tiling: Tile backing board.

1.03 REFERENCE STANDARDS

A. AISI S100-12 - North American Specification for the Design of Cold-Formed Steel Structural Members; American Iron and Steel Institute; 2012.

B. ANSI A108.11 - American National Standard Specifications for Interior Installation of Cementitious Backer Units; 2010 (Reaffirmed 2016).

C. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2015.

D. ASTM C475/C475M - Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board; 2015.

E. ASTM C645 - Standard Specification for Nonstructural Steel Framing Members; 2014.

F. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing; 2012.

G. ASTM C754 - Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products; 2017.

H. ASTM C840 - Standard Specification for Application and Finishing of Gypsum Board; 2013.

I. ASTM C954 - Standard Specification for Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs From 0.033 in. (0.84 mm) to 0.112 in. (2.84 mm) in Thickness; 2015.

J. ASTM C1002 - Standard Specification for Steel Self-Piercing Tapping Screws for Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs; 2016.

K. ASTM C1047 - Standard Specification for Accessories For Gypsum Wallboard and Gypsum Veneer Base; 2014a.

L. ASTM C1177/C1177M - Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing; 2013.

M. ASTM C1178/C1178M - Standard Specification for Coated Glass Mat Water-Resistant Gypsum Backing Panel; 2013.

N. ASTM C1280 - Standard Specification for Application of Gypsum Sheathing Board; 2013.

O. ASTM C1288 - Standard Specification for Discrete Non-Asbestos Fiber-Cement Interior Substrate Sheets; 2014.

P. ASTM C1325 - Specification for Non-Asbestos Fiber-Mat Reinforced Cementitious Backer Units; 2017.

Q. ASTM C1396/C1396M - Standard Specification for Gypsum Board; 2014a.

R. ASTM C1629/C1629M - Standard Classification for Abuse-Resistant Nondecorated Interior Gypsum Panel Products and Fiber-Reinforced Cement Panels; 2015.

S. ASTM C1658/C1658M - Standard Specification for Glass Mat Gypsum Panels; 2013.

T. ASTM D3273 - Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber; 2012.

U. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements; 2009 (Reapproved 2016).

V. ASTM E413 - Classification for Rating Sound Insulation; 2016.

W. GA-216 - Application and Finishing of Gypsum Board; 2013.

X. GA-226 - Application of Gypsum Board to Form Curved Surfaces; Gypsum Association; 2008.

Y. GA-600 - Fire Resistance Design Manual; 2015.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Shop Drawings: Indicate special details associated with fireproofing and acoustic seals.

C. Product Data: Provide data on metal framing, gypsum board, accessories, and joint finishing system.

D. Product Data: Provide manufacturer's data on partition head to structure connectors, showing compliance with requirements.

E. Test Reports: For stud framing products that do not comply with ASTM C645 or ASTM C754, provide independent laboratory reports showing maximum stud heights at required spacings and deflections.

F. Samples: Submit two samples of predecorated gypsum board, 12 by 12 inches in size, illustrating finish color and texture.

1.05 QUALITY ASSURANCE

A. Installer Qualifications: Company specializing in performing gypsum board installation and finishing, with minimum 10 years of experience.

B. Copies of Documents at Site: Maintain at the project site a copy of each referenced document that prescribes execution requirements.

PART 2 PRODUCTS

2.01 GYPSUM BOARD ASSEMBLIES

A. Provide completed assemblies complying with ASTM C840 and GA-216.
   1. See PART 3 for finishing requirements.

B. Interior Partitions, Indicated as Acoustic: Provide completed assemblies with the following characteristics:
   1. Acoustic Attenuation: STC of 45-49 calculated in accordance with ASTM E413, based on tests conducted in accordance with ASTM E90.

C. Fire Rated Assemblies: Provide completed assemblies complying with applicable code.

2.02 METAL FRAMING MATERIALS

A. Manufacturers - Metal Framing, Connectors, and Accessories:
   1. Clarkwestern Dietrich Building Systems LLC: www.clarkdietrich.com.

2. Marino: www.marinoware.com.
3. Phillips Manufacturing Company: www.phillipsmfg.com.
4. Substitutions: See Section 01 6000 - Product Requirements.

B. Non-Loadbearing Framing System Components: ASTM C645; galvanized sheet steel, of size and properties necessary to comply with ASTM C754 for the spacing indicated, with maximum deflection of wall framing of L/120 at 5 psf.
1. Exception: The minimum metal thickness and section properties requirements of ASTM C 645 are waived provided steel of 40 ksi (275 MPa) minimum yield strength is used, the metal is continuously dimpled, the effective thickness is at least twice the base metal thickness, and maximum stud heights are determined by testing in accordance with ASTM E 72 using assemblies specified b ASTM C 754.
2. Studs: "C" shaped with flat or formed webs with knurled faces.
3. Runners: U shaped, sized to match studs.
4. Ceiling Channels: C-shaped.
5. Furring: Hat-shaped sections, minimum depth of 7/8 inch.

C. Loadbearing Studs for Application of Gypsum Board: As specified in Section 05 4000.

D. Shaft Wall Studs and Accessories: ASTM C645; galvanized sheet steel, of size and properties necessary to comply with ASTM C754 and specified performance requirements.

E. Ceiling Hangers: Type and size as specified in ASTM C754 for spacing required.

F. Partition Head to Structure Connections: Provide mechanical anchorage devices that accommodate deflection using slotted holes, screws and anti-friction bushings, preventing rotation of studs while maintaining structural performance of partition.
1. Structural Performance: Maintain lateral load resistance and vertical movement capacity required by applicable code, when evaluated in accordance with AISI S100-12.
2. Material: ASTM A653/A653M steel sheet, SS Grade 50/340, with G60/Z180 hot dipped galvanized coating.
3. Provide components UL-listed for use in UL-listed fire-rated head of partition joint systems indicated on drawings.
4. Deflection and Firestop Track:
    a. Provide mechanical anchorage devices as described above that accommodate deflection while maintaining the fire-rating of the wall assembly.
5. Provide top track preassembled with connection devices spaced to fit stud spacing indicated on drawings; minimum track length of 12 feet.

2.03 BOARD MATERIALS

A. Manufacturers - Gypsum-Based Board:
1. American Gypsum Company: www.americangypsum.com.
2. CertainTeed Corporation: www.certainteed.com.
3. Continental Building Products: www.continental-bp.com.
4. Georgia-Pacific Gypsum: www.gpgypsum.com.
5. National Gypsum Company: www.nationalgypsum.com.
6. USG Corporation: www.usg.com.

B. Gypsum Wallboard: Paper-faced gypsum panels as defined in ASTM C1396/C1396M; sizes to minimize joints in place; ends square cut.
   1. Application: Use for vertical surfaces and ceilings, unless otherwise indicated.
   2. Glass mat faced gypsum panels as defined in ASTM C1658/C1658M, suitable for paint finish, of the same core type and thickness may be substituted for paper-faced board.
   3. At Assemblies Indicated with Fire-Rating: Use type required by indicated tested assembly; if no tested assembly is indicated, use Type X board, UL or WH listed.
   4. Thickness:
      a. Vertical Surfaces: 1/2 inch.
      b. Ceilings: 5/8 inch.
      c. Multi-Layer Assemblies: Thicknesses as indicated on drawings.
   5. Mold Resistant Paper Faced Products:
      a. American Gypsum Company; M-Bloc.
   6. Glass Mat Faced Products:
      a. Georgia-Pacific Gypsum; DensArmor Plus.

C. Abuse Resistant Wallboard:
   1. Application: High-traffic areas indicated.
   2. Surface Abrasion: Level 2, minimum, when tested in accordance with ASTM C1629/C1629M.
   3. Indentation: Level 1, minimum, when tested in accordance with ASTM C1629/C1629M.
   4. Soft Body Impact: Level 1, minimum, when tested in accordance with ASTM C1629/C1629M.
   5. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
   6. Type: Fire resistance rated Type X, UL or WH listed.
   7. Thickness: 5/8 inch.
   8. Edges: Tapered.

D. Backing Board For Wet Areas including backing for Exterior and Interior Adhered Stone: One of the following products:
   1. Application: Surfaces behind adhered stone and tile in wet areas including drinking fountains, backsplashes and where tile is to be installed as indicated on drawings.
   2. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
   3. ANSI Cement-Based Board: Non-gypsum-based; aggregated Portland cement panels with glass fiber mesh embedded in front and back surfaces complying with ANSI A118.9-SystemDeleted or ASTM C1325. Use this board for Exterior Adhered Stone.
      a. Thickness: 1/2 inch.
      b. Products:
         1) Custom Building Products: www.custombuildingproducts.com.
         2) National Gypsum Company; PermaBase Cement Board: www.nationalgypsum.com/#sle.
         3) USG Corporation: www.usg.com.
         4) Substitutions: See Section 01 6000 - Product Requirements.
   4. ASTM Cement-Based Board: Non-gypsum-based, cementitious board complying with ASTM C1288. Use this product for Interior Adhered Stone.
      a. Thickness: 1/2 inch.
      b. Products:
         1) James Hardie Building Products, Inc: www.jameshardie.com.

2) Substitutions: See Section 01 6000 - Product Requirements.

5. Glass Mat Faced Board: Coated glass mat water-resistant gypsum backing panel as defined in ASTM C1178/C1178M.
   a. Regular Type: Thickness 1/2 inch.
   b. Products:
      1) Georgia-Pacific Gypsum; DensShield Tile Backer.
      2) National Gypsum Company; Gold Bond eXP Tile Backer.
      3) Substitutions: See Section 01 6000 - Product Requirements.

E. Backing Board For Non-Wet Areas: Water-resistant gypsum backing board as defined in ASTM C1396/C1396M; sizes to minimum joints in place; ends square cut.
   1. Application: Vertical surfaces behind thinset tile, except in wet areas.
   2. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
   3. At Assemblies Indicated with Fire-Rating: Use type required by indicated tested assembly; if no tested assembly is indicated, use Type X board, UL or WH listed.
   4. Type: Regular and Type X, in locations indicated.
   5. Type X Thickness: 5/8 inch.
   6. Regular Board Thickness: 1/2 inch.
   7. Edges: Tapered.
   8. Products:
      a. American Gypsum Company; M-Bloc.
      b. American Gypsum Company; M-Bloc Type X.
      c. Georgia-Pacific Gypsum; ToughRock Mold-Guard Gypsum Board.
      d. Georgia-Pacific Gypsum; DensArmor Plus.
      e. National Gypsum Company; Gold Bond XP Gypsum Board.
      f. Substitutions: See Section 01 6000 - Product Requirements.

F. Ceiling Board: Special sag resistant gypsum ceiling board as defined in ASTM C1396/C1396M; sizes to minimize joints in place; ends square cut.
   1. Application: Ceilings, unless otherwise indicated.
   2. Thickness: 5/8 inch.
   3. Edges: Tapered.
   4. Products:
      a. Georgia-Pacific Gypsum; ToughRock Span 24 Ceiling Board.
      b. Substitutions: See Section 01 6000 - Product Requirements.

G. Exterior Sheathing Board: Sizes to minimize joints in place; ends square cut.
   1. Application: Exterior sheathing, unless otherwise indicated.
   2. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
   3. Glass Mat Faced Sheathing: Glass mat faced gypsum substrate as defined in ASTM C1177/C1177M.
   4. Core Type: Regular and Type X, as indicated.
   5. Type X Thickness: 1/2 and 5/8 inch.
   6. Regular Board Thickness: 5/8 and 1/2 inch.
   7. Edges: Square.
   8. Glass Mat Faced Products:
      a. American Gypsum Company; M-Glass Exterior Sheathing.
      b. Continental Building Products; Weather Defense Platinum Exterior Sheathing.

c. Georgia-Pacific Gypsum; DensGlass Sheathing and DensDeck Prime.
d. National Gypsum Company; Gold Bond eXP Sheathing.
e. Substitutions: See Section 01 6000 - Product Requirements.

H. Exterior Soffit Board: Exterior gypsum soffit board as defined in ASTM C1396/C1396M; sizes to minimize joints in place; ends square cut.
1. Application: Ceilings and soffits in protected exterior areas, unless otherwise indicated.
2. At Assemblies Indicated with Fire-Rating: Use type required by indicated tested assembly; if no tested assembly is indicated, use Type X.
3. Types: Regular and Type X, in locations indicated.
4. Type X Thickness: 1/2 and 5/8 inch.
5. Regular Type Thickness: 5/8 and 1/2 inch.
6. Edges: Tapered.
7. Products:
a. Georgia-Pacific Gypsum; ToughRock Fireguard C Soffit Board.

I. Parapet Sheathing at Membrane Roofing: Roof board.
1. Fiberglass mat faced gypsum board with non-asphaltic heat-cured coating on one side.
2. Edges: Square
3. Thickness: 5/8"
4. Size: Nominal 4'x8"
5. Fire Resistance: Flame Spread 0, smoke developed 0 as described and tested in accordance with ASTM E 84. Noncombustible as described and tested in accordance with ASTM E 136.
6. Products: Georgia-Pacific DensDeck Prime

J. Shaftwall and Coreboard: Type X; 1 inch thick by 24 inches wide, beveled long edges, ends square cut.
1. Paper-Faced Type: Gypsum shaftliner board or gypsum coreboard as defined ASTM C1396/C1396M; water-resistant faces.
2. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
3. Products:
a. American Gypsum Company; Shaft Liner.
b. Georgia-Pacific Gypsum; ToughRock Shaftliner.
c. National Gypsum Company; Gold Bond Fire-Shield Shaftliner XP.
d. Substitutions: See Section 01 6000 - Product Requirements.

2.04 Gypsum Wallboard ACCESSORIES

A. Acoustic Sealant: Acrylic emulsion latex or water-based elastomeric sealant; do not use solvent-based non-curing butyl sealant.

B. Water-Resistive Barrier: .

C. Finishing Accessories: ASTM C1047, galvanized steel or rolled zinc, unless noted otherwise.
1. Types: As detailed or required for finished appearance.
2. Special Shapes: In addition to conventional corner bead and control joints, provide U-bead at exposed panel edges.

D. Joint Materials: ASTM C475/C475M and as recommended by gypsum board manufacturer for project conditions.
   1. Fiberglass Tape: 2 inch wide, coated glass fiber tape for joints and corners, except as otherwise indicated.
   2. Paper Tape: 2 inch wide, creased paper tape for joints and corners, except as otherwise indicated.
   3. Ready-mixed vinyl-based joint compound.
   4. Chemical hardening type compound.
   5. Joint Compound: Setting type, field-mixed.

E. High Build Drywall Surfacer: Vinyl acrylic latex-based coating for spray application, designed to take the place of skim coating and separate paint primer in achieving Level 5 finish.

F. Textured Finish Materials: Latex-based compound; plain.

G. Screws for Fastening of Gypsum Panel Products to Cold-Formed Steel Studs Less than 0.033 inch in Thickness and Wood Members: ASTM C1002; self-piercing tapping screws, corrosion resistant.

H. Screws for Fastening of Gypsum Panel Products to Steel Members from 0.033 to 0.112 inch in Thickness: ASTM C954; steel drill screws, corrosion resistant.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that project conditions are appropriate for work of this section to commence.

3.02 SHAFT WALL INSTALLATION

A. Shaft Wall Framing: Install in accordance with manufacturer's installation instructions.

B. Shaft Wall Liner: Cut panels to accurate dimension and install sequentially between special friction studs.
   1. On walls over sixteen feet high, screw-attach studs to runners top and bottom.
   2. Seal perimeter of shaft wall and penetrations with acoustical sealant.

3.03 FRAMING INSTALLATION

A. Metal Framing: Install in accordance with ASTM C754 and manufacturer's instructions.

B. Suspended Ceilings and Soffits: Space framing and furring members as indicated.

C. Studs: Space studs at 16 inches on center.
   1. Extend partition framing to structure where indicated and to ceiling in other locations.
   2. Partitions Terminating at Ceiling: Attach ceiling runner securely to ceiling track in accordance with manufacturer's instructions.
   3. Partitions Terminating at Structure: Attach top runner to structure, maintain clearance between top of studs and structure, and connect studs to track using specified mechanical

devices in accordance with manufacturer's instructions; verify free movement of top of stud connections; do not leave studs unattached to track.

D. Openings: Reinforce openings as required for weight of doors or operable panels, using not less than double studs at jambs.

E. Standard Wall Furring: Install at concrete walls scheduled to receive gypsum board, not more than 4 inches from floor and ceiling lines and abutting walls. Secure in place on alternate channel flanges at maximum 24 inches on center.
   1. Orientation: Horizontal.

F. Acoustic Furring: Install resilient channels at maximum 24 inches on center. Locate joints over framing members.

G. Furring for Fire Ratings: Install as required for fire resistance ratings indicated and to GA-600 requirements.

H. Blocking: Install wood blocking for support of:
   1. Framed openings.
   2. Wall mounted cabinets.
   3. Plumbing fixtures.
   4. Toilet partitions.
   5. Toilet accessories.
   6. Wall mounted door hardware.
   7. Dental and X-Ray Equipment.

3.04 ACOUSTIC ACCESSORIES INSTALLATION

A. Acoustic Insulation: Place tightly within spaces, around cut openings, behind and around electrical and mechanical items within partitions, and tight to items passing through partitions.

B. Acoustic Sealant: Install in accordance with manufacturer's instructions.
   1. Place continuous bead at perimeter of each layer of gypsum board.
   2. Seal around all penetrations by conduit, pipe, ducts, and rough-in boxes, except where firestopping is provided.

3.05 BOARD INSTALLATION

A. Comply with ASTM C840, GA-216, and manufacturer's instructions. Install to minimize butt end joints, especially in highly visible locations.

B. Fire-Rated Construction: Install gypsum board in strict compliance with requirements of assembly listing.

C. Exterior Sheathing: Comply with ASTM C1280. Install sheathing vertically, with edges butted tight and ends occurring over firm bearing.
   1. Paper-Faced Sheathing: Immediately after installation, protect from weather by application of water-resistive barrier.

D. Exterior Soffits: Install exterior soffit board perpendicular to framing, with staggered end joints over framing members or other solid backing.

E. Cementitious Backing Board: Install over steel framing members and plywood substrate where indicated, in accordance with ANSI A108.11 and manufacturer's instructions.

F. Installation on Metal Framing: Use screws for attachment of gypsum board except face layer of non-rated double-layer assemblies, which may be installed by means of adhesive lamination.

3.06 INSTALLATION OF TRIM AND ACCESSORIES

A. Control Joints: Place control joints consistent with lines of building spaces and as indicated.
   1. Not more than 30 feet apart on walls and ceilings over 50 feet long.
   2. At exterior soffits, not more than 30 feet apart in both directions.

B. Corner Beads: Install at external corners, using longest practical lengths.

C. Edge Trim: Install at locations where gypsum board abuts dissimilar materials.

3.07 JOINT TREATMENT

A. Glass Mat Faced Gypsum Board and Exterior Glass Mat Faced Sheathing: Use fiberglass joint tape, embed and finish with setting type joint compound.

B. Paper Faced Gypsum Board: Use paper joint tape, bedded with ready-mixed vinyl-based joint compound and finished with ready-mixed vinyl-based joint compound.

C. Finish gypsum board in accordance with levels defined in ASTM C840, as follows:
   1. Level 5: Walls and ceilings to receive satin, semi-gloss or gloss paint finish or wall coverings and other areas specifically indicated.
   2. Level 4: Walls and ceilings to receive paint finish or light textured finish, unless otherwise indicated.
   3. Level 2: In utility areas, behind cabinetry, and on backing board to receive tile finish.
   4. Level 1: Fire rated wall areas above finished ceilings, whether or not accessible in the completed construction.
   5. Level 0: Temporary partitions.

D. Tape, fill, and sand exposed joints, edges, and corners to produce smooth surface ready to receive finishes.
   1. Feather coats of joint compound so that camber is maximum 1/32 inch.

E. Where Level 5 finish is indicated, spray apply high build drywall surfacer over entire surface after joints have been properly treated; achieve a flat and tool mark-free finish.

F. Fill and finish joints and corners of cementitious backing board as recommended by manufacturer.

3.08 TEXTURE FINISH

A. Apply finish texture coating by means of spraying apparatus in accordance with manufacturer's instructions and to match approved sample.

3.09 TOLERANCES

A. Maximum Variation of Finished Gypsum Board Surface from True Flatness: 1/8 inch in 10 feet in any direction.

END OF SECTION

SECTION 09 2400 - PORTLAND CEMENT PLASTERING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Portland cement plaster for installation over metal lath.

1.02 RELATED REQUIREMENTS

A. Section 05 4000 - Cold-Formed Metal Framing: Structural metal framing for plaster.

B. Section 09 2116 - Gypsum Board Assemblies: Metal stud framing and furring for plaster.

C. Section 09 2116 - Gypsum Board Assemblies: Acoustical sealing in conjunction with metal stud framing and furring for plaster.

D. Section 09 2236.23 - Metal Lath: Metal furring and lathing for plaster.

E. Section 09 9113 - Exterior Painting.

1.03 REFERENCE STANDARDS

A. ASTM C150/C150M - Standard Specification for Portland Cement; 2016.

B. ASTM C926 - Standard Specification for Application of Portland Cement-Based Plaster; 2016b.

C. ICC (IBC) - International Building Code; 2015.

D. PCA EB049 - Portland Cement Plaster/Stucco Manual; 2003.

E. UL (FRD) - Fire Resistance Directory; current edition.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittals procedures.

B. Product Data: Provide data on plaster materials, characteristics and limitations of products specified.

1.05 QUALITY ASSURANCE

A. Installer Qualifications: Company specializing in performing the work of this section with minimum three years documented experience.

1.06 MOCK-UP

A. Construct mock-up of exterior wall, 8 feet long by 8 feet wide, illustrating surface finish.

B. Mock-up may remain as part of the Work.

1.07 FIELD CONDITIONS

A. Do not apply plaster when substrate or ambient air temperature is under 50 degrees F or over 80 degrees F.

B. Maintain minimum ambient temperature of 50 degrees F during installation of plaster and until cured.

PART 2 PRODUCTS

2.01 PORTLAND CEMENT PLASTER ASSEMBLIES

A. Exterior Stucco: Portland cement plaster system, made of finish, brown, and scratch coat and reinforcing mesh.
   1. Provide continuous exterior insulation as part of the system.
   2. Provide weather resistive barrier and air barrier as part of the system, by the same manufacturer.
   3. Manufacturers:
      a. Master Wall, Inc.; Cemplaster Fiberstucco: www.masterwall.com/sle.
      b. Parex USA, Inc.; Armourwall 300 WaterMaster Krak-Shield: www.parexusa.com.
      c. Sto Corp; Sto Powerwall: www.stocorp.com/sle.
      d. Substitutions: See Section 01 6000 - Product Requirements.

2.02 PLASTER MATERIALS

A. Portland Cement, Aggregates, and Other Materials: In accordance with ASTM C926.

B. Premixed Base Coat: Mixture of cement, aggregate, and proprietary admixtures for scratch and brown coats, installed in accordance with ASTM C926.

C. Premixed Textured Coating: Polymer modified acrylic coating, integrally colored, trowel applied to substrates prepared in accordance with manufacturer's recommendations.

2.03 METAL LATH

A. Metal Lath and Accessories: As specified in Section 09 2236.

B. Beads, Screeds, and Joint Accessories: As specified in Section 09 2236.

2.04 PLASTER MIXES

A. Over Metal Lath: Three-coat application, mixed and proportioned in accordance with manufacturer's instructions.

B. Premixed Plaster Materials: Mix in accordance with manufacturer's instructions.

C. Mix only as much plaster as can be used prior to initial set.

D. Mix materials dry, to uniform color and consistency, before adding water.

E. Protect mixtures from freezing, frost, contamination, and excessive evaporation.

F. Do not retemper mixes after initial set has occurred.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify the suitability of existing conditions before starting work.

B. Metal Lath and Accessories: Verify lath is flat, secured to substrate, and joint and surface perimeter accessories are in place.

3.02 PLASTERING

A. Apply premixed plaster in accordance with manufacturer's instructions.

B. Apply plaster in accordance with ASTM C926.

C. Three-Coat Application Over Metal Lath:
   1. Apply first coat to a nominal thickness of 3/8 inch.
   2. Apply second coat to a nominal thickness of 3/8 inch.
   3. Apply finish coat to a nominal thickness of 1/8 inch.

D. Moist cure base coats.

E. Apply second coat immediately following initial set of first coat.

F. After curing, dampen previous coat prior to applying finish coat.

G. Avoid excessive working of surface. Delay troweling as long as possible to avoid drawing excess fines to surface.

H. Moist cure finish coat for minimum period of 48 hours.

3.03 TOLERANCES

A. Maximum Variation from True Flatness: 1/8 inch in 10 feet.

END OF SECTION

SECTION 09 3000 - TILING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Tile for floor applications.

B. Tile for wall applications.

C. Tile for counters.

D. Cementitious backer board as tile substrate.

E. Ceramic accessories.

1.02 REFERENCE STANDARDS

A. ANSI A108/A118/A136 - American National Standard Specifications for the Installation of Ceramic Tile (Compendium); 2017.

PART 2 PRODUCTS

2.01 TRIM AND ACCESSORIES

A. Ceramic Accessories: Glazed finish, same color and finish as adjacent field tile; same manufacturer as tile.

2.02 SETTING MATERIALS

2.03 GROUTS

END OF SECTION

SECTION 09 6500 - RESILIENT FLOORING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Resilient sheet vinyl flooring.

B. Luxury Vinyl Tile flooring

C. Installation accessories.

1.02 RELATED REQUIREMENTS

A. Section 03 3000 - Cast-in-Place Concrete: Restrictions on curing compounds for concrete slabs and floors.

1.03 REFERENCE STANDARDS

A. ASTM E648 - Standard Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source; 2014c.

B. ASTM F710 - Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring; 2011.

C. ASTM F970 - Standard Test Method for Static Load Limit; 2007 (Reapproved 2011).

D. ASTM F1066 - Standard Specification for Vinyl Composition Floor Tile; 2004 (Reapproved 2014).

E. ASTM F1303 - Standard Specification for Sheet Vinyl Floor Covering with Backing; 2004 (Reapproved 2014).

F. ASTM F1700 - Standard Specification for Solid Vinyl Tile; 2013a.

G. ASTM F1861 - Standard Specification for Resilient Wall Base; 2008 (Reapproved 2012).

H. NFPA 253 - Standard Method of Test for Critical Radiant Flux of Floor Covering Systems Using a Radiant Heat Energy Source; 2015.

I. RFCI (RWP) - Recommended Work Practices for Removal of Resilient Floor Coverings; Resilient Floor Covering Institute; October 2011.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide data on specified products, describing physical and performance characteristics; including sizes, patterns and colors available; and installation instructions.

C. Shop Drawings: Indicate seaming plans and floor patterns.

D. Selection Samples: Submit manufacturer's complete set of color samples for Architect's initial selection.

E. Verification Samples: Submit two samples, 12 by 12 inch in size illustrating color and pattern for each resilient flooring product specified.

F. Concrete Testing Standard: Submit a copy of ASTM F710.

G. Moisture Test Results must be submitted to the Flooring Distributor prior to delivery and installation of resilient sheet flooring.

H. Do not install when the moisture vapor emission rate (MVER) exceed 5lbs. per 1,000 sq.ft. per 24 hours, when using the anhydrous calcium chloride test (ASTM F1869). MVER must be diminishing over time. Do not install when the relative humidity (RH) of the concrete slab exceeds 80% (ASTM F2170).

I. Concrete pH must exceed 9. Perform test and submit results to Flooring Distributor.

J. Certification: Prior to installation of flooring, submit written certification by flooring manufacturer and adhesive manufacturer that condition of sub-floor is acceptable.

K. Maintenance Data: Include maintenance procedures, recommended maintenance materials, and suggested schedule for cleaning, stripping, and re-waxing.

L. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 01 6000 - Product Requirements, for additional provisions.
   2. Extra Flooring Material: 40 square feet of each type and color.
   3. Extra Wall Base: 20 linear feet of each type and color.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Upon receipt, immediately remove any shrink-wrap and check materials for damage and the correct style, color, quantity and run numbers.

B. Store all materials off of the floor in an acclimatized, weather-tight space.

C. Maintain temperature in storage area between 55 degrees F and 90 degrees F.

D. Deliver materials to project site in manufacturer's original, unopened containers with labels indicating brand names, colors and patterns, and quality designations legible and intact.

E. Store and protect materials in accordance with manufacturer's recommendations.

F. Do not store luxury vinyl planks on their sides or edges prior to installation. Cartons must remain flat during acclimation to insure proper dimensional stability during installation.

G. Protect roll materials from damage by storing on end.

H. Do not double stack pallets.

1.06 FIELD CONDITIONS

A. Store materials for not less than 48 hours prior to installation in area of installation at a temperature of 70 degrees F to achieve temperature stability. Thereafter, maintain conditions above 55 degrees F.

1.07 **QUALITY ASSURANCE**

A. Provide each type of resilient sheet flooring and accessories from a manufacturer, including recommended primers, adhesives, sealants and leveling compounds.

1.08 **EXTRA MATERIALS**

A. Furnish one percent for each color installed.

1.09 **WARRANTY**

A. Twelve (12) year limited warranty commencing on date of substantial completion.

PART 2 PRODUCTS

2.01 **COMPOSITION SHEET AND TILE FLOORING**

A. Sheet Vinyl Flooring (with backing for fitness areas) - Type SV-1: As indicated on Interior Material Schedule: Sheet vinyl floor covering manufactured from 90% recycled polyvinylchloride, interlaced with strand reinforcement with matte or gloss finish.
   1. Manufacturers:
      a. LONSEAL: https://lonseal.com/products/product-details/line/LONWOOD%20PERFORMA/.
      b. Substitutions: See Section 01 6000 - Product Requirements.
   2. Per ASTM F1303: Type I, Grade I, Class B, Commercial Us
   3. Per ASTM F2772: Force Reduction Class 1
   4. Meets NCAA Basketball Rebound Requirements (49” – 54)
   5. Meet or exceed ASTM F970
   6. Sheet Size: 60 inch wide by 60 or 96 inch long.
   7. Static Load Resistance: 641 psi minimum, when tested as specified in ASTM D-695.
   8. Color: To be selected by Architect from manufacturer's full range.

2.02 TILE FLOORING

A. Luxury Vinyl Tile: Surface-decorated, with wear layer, directional wood-grained cushioned high performance luxury vinyl:
   1. Manufacturers:
      a. Basis of Design: Parterre; https://parterreflooring.com/ .
      b. Substitutions: See Section 01 6000 - Product Requirements.
   2. Minimum Requirements: Comply with ASTM F1700, of Class corresponding to type specified.

3. Critical Radiant Flux (CRF): Minimum 0.45 watt per square centimeter, when tested in accordance with ASTM E 648 or NFPA 253.
4. Static Load: ASTM F970 1500 psi.
5. Anitmicrobial: FlorSept
6. Slip Resistance: ASTM D2048 >0.65
7. Residual Indentation: ASTM F1914 <8%
8. Resistance to Fungi: ASTM G21 - 0:fungi free
9. Antibacterial Activity: Resists the propoagation of bacteria.
10. Wear Layer Thickness: 0.5 mm.
11. Total Thickness: 3 mm, Non-cushioned.
12. Color: As indicated on drawings.

B. See Finish and Material Schedules.

2.03 ACCESSORIES

A. Subfloor Filler: White premix latex; type recommended by adhesive material manufacturer.

B. Primers, Adhesives, and Seam Sealer: Waterproof; types recommended by flooring manufacturer.

C. Patching, Leveling, Underlayment: Mastic Latex type equivalent to Camps latex underlayment.

D. Terminated Reducers: Manufacturer's standard; color as selected.

E. Moldings, Transition and Edge Strips: Same material as flooring.

F. Filler for Coved Base: Plastic.

G. Adhesives: As recommended by manufacturer to suit floor coveing products, type of traffic conditions expected, and substrate conditions indicated.

H. Trowelable underlayments and patching compounds: cementitious formulation recommended by floor covering manufacturer for applications indicated, with minimum compressive strength of 3,500 psi.

I. Sealer and Wax: Types recommended by flooring manufacturer.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that surfaces are flat to tolerances acceptable to flooring manufacturer, free of cracks that might telegraph through flooring, clean, dry, and free of curing compounds, surface hardeners, and other chemicals that might interfere with bonding of flooring to substrate.

B. Verify that wall surfaces are smooth and flat within the tolerances specified for that type of work, are dust-free, and are ready to receive resilient base.

C. Cementitious Sub-floor Surfaces: Verify that substrates are dry enough and ready for resilient flooring installation by testing for moisture and pH.
1. Test in accordance with ASTM F710.

2. Obtain instructions if test results are not within limits recommended by resilient flooring manufacturer and adhesive materials manufacturer.
3. Slab substrates must be dry and free of curing compounds, sealers, hardeners, and other materials whose presence would interfere with bonding of adhesive. Determine adhesion and dryness characteristics by performing bond and moisture tests recommended by floor covering manufacturer.

D. Verify that required floor-mounted utilities are in correct location.

E. Do not allow resilient sheet flooring work to proceed until subfloor surfaces are satisfactory. Indicate adverse conditions of any type by letter to Architect and Flooring Distributor.

F. Perform bond test at the rate of one per 50 square feet.

3.02 PREPARATION

A. Remove existing resilient flooring and flooring adhesives; follow the recommendations of RFCI (RWP).

B. Prepare floor substrates as recommended by flooring and adhesive manufacturers.

C. Remove sub-floor ridges and bumps. Fill minor low spots, cracks, joints, holes, and other defects with sub-floor filler to achieve smooth, flat, hard surface.

D. Prohibit traffic until filler is fully cured.

E. Remove all debris, sand, and other foreign materials or substances which may result in lack of adhesion, telegraphing or bleed through.

F. Broom or vacuum clean substrates to be covered immediately before installation. Following cleaning, examine substrates to determine if there is any evidence of moisture, alkaline salts, carbonation or dust..

3.03 Installation - General

A. Starting installation constitutes acceptance of sub-floor conditions.

B. Install in accordance with manufacturer's written instructions.

C. Maintain reference markers, holes, or openings that are in place or plainly marked for future cutting by repeating on finish flooring as marked on subfloor. Use chalk or other non-staining marking device.

D. Spread only enough adhesive to permit installation of materials before initial set.

E. Fit joints and butt seams tightly.

F. Set flooring in place, press with heavy roller to attain full adhesion.

G. Where type of floor finish, pattern, or color are different on opposite sides of door, terminate flooring under centerline of door.

H. Extend resilient sheet flooring into toe spaces, door reveals and into closets and similar openings.

I. Install edge strips at unprotected or exposed edges, where flooring terminates, and where indicated.
   1. Metal Strips: Attach to substrate before installation of flooring using stainless steel screws.
   2. Resilient Strips: Attach to substrate using adhesive.

J. Scribe flooring to walls, columns, cabinets, floor outlets, and other appurtenances to produce tight joints.

K. Flooring should be installed prior to use of any other items that may be necessary for installing on top of the finished floor.

L. For glue-down installations scribe, cut and fit floor coverings to fit tightly to vertical surfaces, permanent fixtures, and built-in furniture such as cabinets, pipes, outlets, edgings,

M. Install feature strips where indicated.

N. Extend floor coverings into toe spaces, door reveals, closets, and similar openings.

3.04 Installation - Tile Flooring

A. Mix tile from container to ensure shade variations are consistent when tile is placed, unless otherwise indicated in manufacturer's installation instructions.

B. Lay flooring with joints and seams parallel to building lines to produce symmetrical pattern.

C. Find the center of the floor by marking vertical and horizontal lines across the floors at the center of the walls. Measure the squareness of the marked lines, and then begin to work from the center outwards, leaving a 0.12" expansion gap along the perimeter between the flooring and walls.

3.05 Installation - Resilient Base

A. Fit joints tightly and make vertical. Maintain minimum dimension of 18 inches between joints.

B. Miter internal corners. At external corners, use premolded units. At exposed ends, use premolded units.

C. Install base on solid backing. Bond tightly to wall and floor surfaces.

D. Scribe and fit to door frames and other interruptions.

3.06 CLEANING

A. Remove excess adhesive from floor, base, and wall surfaces without damage.

B. Clean in accordance with manufacturer's written instructions.

3.07 PROTECTION

A. Prohibit traffic on resilient flooring for 48 hours after installation. Do not allow rolling carts to be used on the floor for at least 72 hours.

END OF SECTION

SECTION 09 6816 - SHEET CARPETING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Carpet, stretched-in with cushion underlay.

1.02 RELATED REQUIREMENTS

A. Section 26 0539 - Underfloor Raceways for Electrical Systems: Electrical and telephone floor cover plate with recess for carpet.

1.03 REFERENCE STANDARDS

A. ASTM D2859 - Standard Test Method for Ignition Characteristics of Finished Textile Floor Covering Materials; 2006 (Reapproved 2011).

B. ASTM E648 - Standard Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source; 2014c.

C. ASTM F710 - Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring; 2011.

D. CRI 104 - Standard for Installation of Commercial Carpet; 2015.

E. CRI (GL) - Green Label Testing Program - Certified Products; Current Edition.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide data on specified products, describing physical and performance characteristics; sizes, patterns, colors available, and method of installation.

C. Samples: Submit two samples _24___by_36___ inch in size illustrating color and pattern for each carpet and cushion material specified.

D. Manufacturer's Installation Instructions: Indicate special procedures.

E. Maintenance Data: Include maintenance procedures, recommended maintenance materials, and suggested schedule for cleaning.

F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 01 6000 - Product Requirements, for additional requirements.
   2. Extra Carpet: 60 sq ft of each type, color, and pattern installed.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing specified carpet with minimum three years documented experience.

B. Installer Qualifications: Company specializing in installing carpet with minimum three years documented experience.

1.06 FIELD CONDITIONS

A. Store materials in area of installation for minimum period of 24 hours prior to installation.

B. Maintain minimum 70 degrees F ambient temperature 24 hours prior to, during and 24 hours after installation.

C. Ventilate installation area during installation and for 72 hours after installation.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Carpet:
1. Interface, Inc; _____: www.interfaceinc.com/#sle.
2. J & J Industries, Inc; _____: www.jjindustries.com/#sle.
3. Milliken & Company; _____: www.milliken.com/#sle.
4. BASIS OF DESIGN: SHAW CARPET - SEE SCHEDULE.

B. Cushion:
1. FXI | Foam Innovation; _____: www.fxi.com/#sle.
2. Proflex Products, Inc; DB-250: www.proflex.us/#sle.
3. Leggett & Platt, Inc; _____: www.lpurethane.com/#sle.
4. BASIS OF DESIGN: SHAW CARPET PER MANF..

2.02 CARPET

A. Carpet, Type per interior material schedule.:
1. Surface Flammability Ignition: Pass ASTM D2859 (the "pill test").
2. Substitutions: See Section 01 6000 - Product Requirements.

2.03 CUSHION

A. Cushion, Type per: manf..

2.04 ACCESSORIES

A. Sub-Floor Filler: Type recommended by carpet manufacturer.

B. Tackless Strip: Carpet gripper, of type recommended by carpet manufacturer to suit application, with attachment devices.

C. Adhesives:
1. Compatible with materials being adhered; maximum VOC content of 50 g/L; CRI (GL) certified; in lieu of labeled product, independent test report showing compliance is acceptable.

D. Seam Adhesive: Recommended by carpet manufacturer.

E. Carpet Adhesive: Recommended by carpet manufacturer; releasable type.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that sub-floor surfaces are smooth and flat within the tolerances specified for that type of work and are ready to receive carpet.

B. Verify that wall surfaces are smooth and flat within the tolerances specified for that type of work, are dust-free, and are ready to receive carpet.

C. Verify that sub-floor surfaces are dust-free and free of substances that could impair bonding of adhesives to sub floor surfaces.

D. Cementitious Sub-floor Surfaces: Verify that substrates are dry enough and ready for flooring installation by testing for moisture and alkalinity (pH).
   1. Obtain instructions if test results are not within limits recommended by flooring material manufacturer and adhesive materials manufacturer.

E. Verify that required floor-mounted utilities are in correct location.

3.02 PREPARATION

A. Prepare floor substrates as recommended by flooring and adhesive manufacturers.

B. Remove sub-floor ridges and bumps. Fill minor or local low spots, cracks, joints, holes, and other defects with sub-floor filler.

C. Apply, trowel, and float filler to achieve smooth, flat, hard surface. Prohibit traffic until filler is cured.

D. Clean substrate.

3.03 INSTALLATION - GENERAL

A. Starting installation constitutes acceptance of sub-floor conditions.

B. Install carpet and cushion in accordance with manufacturer's instructions and CRI 104 (Commercial).

C. Verify carpet match before cutting to ensure minimal variation between dye lots.

D. Lay out carpet and locate seams in accordance with shop drawings.
   1. Locate seams in area of least traffic, out of areas of pivoting traffic, and parallel to main traffic.
   2. Do not locate seams perpendicular through door openings.
   3. Align run of pile in same direction as anticipated traffic and in same direction on adjacent pieces.

4. Locate change of color or pattern between rooms under door centerline.
5. Provide monolithic color, pattern, and texture match within any one area.

E. Install carpet tight and flat on subfloor, well fastened at edges, with a uniform appearance.

3.04 STRETCHED-IN CARPET

A. Install tackless strips with pins facing the wall around entire perimeter, except across door openings. Use edge strip where carpet terminates at other floor coverings.

B. Space tackless strips slightly less than carpet thickness away from vertical surfaces, but not more than 3/8 inch.

C. Install cushion in maximum size pieces using spot adhesive to adhere to sub-floor.

D. Lay out cushion so that seams will be perpendicular to, or offset from, minimum 6 inches from carpet seams.

E. Butt cushion edges together and tape seams.

F. Trim cushion tight to edge of tackless strip and around projections and contours.

G. Double cut carpet seams, with accurate pattern match. Make cuts straight, true, and unfrayed. Apply seam adhesive to all cut edges immediately.

H. Join seams by hand sewing. Form seams straight, not overlapped or peaked, and free of gaps.

I. Following seaming, hook carpet onto tackless strip at one edge, power stretch, and hook firmly at other edges. Follow manufacturer's recommendations for method and amount of stretch.

J. Trim carpet neatly at walls and around interruptions. Tuck edges into space between tackless strip and wall.

3.05 DIRECT-GLUED CARPET

A. Double cut carpet seams, with accurate pattern match. Make cuts straight, true, and unfrayed. Apply seam adhesive to cut edges of woven carpet immediately.

B. Apply contact adhesive to floor uniformly at rate recommended by manufacturer. After sufficient open time, press carpet into adhesive.

C. Apply seam adhesive to the base of the edge glued down. Lay adjoining piece with seam straight, not overlapped or peaked, and free of gaps.

D. Roll with appropriate roller for complete contact of adhesive to carpet backing.

E. Trim carpet neatly at walls and around interruptions.

3.06 CLEANING

A. Remove excess adhesive from floor and wall surfaces without damage.

B. Clean and vacuum carpet surfaces.

END OF SECTION

SECTION 09 9113 - EXTERIOR PAINTING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Surface preparation.

B. Field application of paints.

C. Scope: Finish exterior surfaces exposed to view, unless fully factory-finished and unless otherwise indicated, including the following:

D. Do Not Paint or Finish the Following Items:
   1. Items factory-finished unless otherwise indicated; materials and products having factory-applied primers are not considered factory finished.
   2. Items indicated to receive other finishes.
   3. Items indicated to remain unfinished.
   4. Fire rating labels, equipment serial number and capacity labels, and operating parts of equipment.
   5. Floors, unless specifically indicated.
   6. Glass.
   7. Concealed pipes, ducts, and conduits.

1.02 RELATED REQUIREMENTS

A. Section 09 9123 - Interior Painting.

B. Section 09 9600 - High-Performance Coatings.

C. Section 09 0723 Concrete and Masonry Coatings.

1.03 REFERENCE STANDARDS

A. MPI (APSM) - Master Painters Institute Architectural Painting Specification Manual; Current Edition.

PART 2 PRODUCTS

2.01 PAINTS AND FINISHES - GENERAL

A. Paints and Finishes: Ready mixed, unless required to be a field-catalyzed paint.
   1. Provide paints and finishes of a soft paste consistency, capable of being readily and uniformly dispersed to a homogeneous coating, with good flow and brushing properties, and capable of drying or curing free of streaks or sags.
   2. Supply each paint material in quantity required to complete entire project's work from a single production run.
   3. Do not reduce, thin, or dilute paint or finishes or add materials unless such procedure is specifically described in manufacturer's product instructions.

2.02 PAINT SYSTEMS - EXTERIOR

PART 3 EXECUTION

3.01 PREPARATION

A. Clean surfaces thoroughly and correct defects prior to application.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

C. Remove or mask surface appurtenances, including electrical plates, hardware, light fixture trim, escutcheons, and fittings, prior to preparing surfaces for finishing.

D. Seal surfaces that might cause bleed through or staining of topcoat.

E. Remove mildew from impervious surfaces by scrubbing with solution of tetra-sodium phosphate and bleach. Rinse with clean water and allow surface to dry.

F. Exterior Gypsum Board: Fill minor defects with exterior filler compound. Spot prime defects after repair.

G. Exterior Plaster: Fill hairline cracks, small holes, and imperfections with exterior patching plaster. Make smooth and flush with adjacent surfaces. Wash and neutralize high alkali surfaces.

3.02 APPLICATION

A. Apply products in accordance with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual".

B. Do not apply finishes to surfaces that are not dry. Allow applied coats to dry before next coat is applied.

C. Apply each coat to uniform appearance.

D. Vacuum clean surfaces of loose particles. Use tack cloth to remove dust and particles just prior to applying next coat.

E. Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings removed prior to finishing.

3.03 COLOR SCHEDULE

END OF SECTION

SECTION 09 9123 - INTERIOR PAINTING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Surface preparation.

B. Field application of paints.

C. Scope: Finish interior surfaces exposed to view, unless fully factory-finished and unless otherwise indicated.
   1. Mechanical and Electrical:
      a. In finished areas, paint insulated and exposed pipes, conduit, boxes, insulated and exposed ducts, hangers, brackets, collars and supports, mechanical equipment, and electrical equipment, unless otherwise indicated.

D. Do Not Paint or Finish the Following Items:
   1. Items factory-finished unless otherwise indicated; materials and products having factory-applied primers are not considered factory finished.
   2. Items indicated to receive other finishes.
   3. Items indicated to remain unfinished.
   4. Fire rating labels, equipment serial number and capacity labels, bar code labels, and operating parts of equipment.
   5. Floors, unless specifically indicated.
   6. Glass.
   7. Concealed pipes, ducts, and conduits.

1.02 REFERENCE STANDARDS

A. 40 CFR 59, Subpart D - National Volatile Organic Compound Emission Standards for Architectural Coatings; U.S. Environmental Protection Agency; current edition.

B. MPI (APSM) - Master Painters Institute Architectural Painting Specification Manual; Current Edition.

C. SSPC-SP 1 - Solvent Cleaning; 2015, with Editorial Revision (2016).

D. SSPC-SP 6 - Commercial Blast Cleaning; 2007.

1.03 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide complete list of products to be used, with the following information for each:
   1. Manufacturer's name, product name and/or catalog number, and general product category (e.g. "alkyd enamel").
   2. MPI product number (e.g. MPI #47).

3. Cross-reference to specified paint system(s) product is to be used in; include description of each system.

C. Samples: Submit three paper "draw down" samples, 8-1/2 by 11 inches in size, illustrating range of colors available for each finishing product specified.
   1. Where sheen is specified, submit samples in only that sheen.

D. Certification: By manufacturer that paints and finishes comply with VOC limits specified.

1.04 QUALITY ASSURANCE

1.05 MOCK-UP

A. See Section 01 4000 - Quality Requirements, for general requirements for mock-up.

B. Locate where directed by Architect.

C. Mock-up may remain as part of the work.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.

B. Container Label: Include manufacturer's name, type of paint, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.

C. Paint Materials: Store at minimum ambient temperature of 45 degrees F and a maximum of 90 degrees F, in ventilated area, and as required by manufacturer's instructions.

1.07 FIELD CONDITIONS

A. Do not apply materials when surface and ambient temperatures are outside the temperature ranges required by the paint product manufacturer.

B. Follow manufacturer's recommended procedures for producing best results, including testing of substrates, moisture in substrates, and humidity and temperature limitations.

C. Provide lighting level of 80 ft candles measured mid-height at substrate surface.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Provide paints and finishes from the same manufacturer to the greatest extent possible.
   1. In the event that a single manufacturer cannot provide specified products, minor exceptions will be permitted provided approval by Architect is obtained using the specified procedures for substitutions.
   2. Substitution of MPI-approved products by a different manufacturer is preferred over substitution of unapproved products by the same manufacturer.

B. Paints:
   1. Base Manufacturer: PPG Paints.
   2. Behr Process Corporation: www.behr.com/#sle.
   3. PPG Paints: www.ppgpaints.com/#sle.
   4. Sherwin-Williams Company: www.sherwin-williams.com/#sle.

2.02 PAINTS AND FINISHES - GENERAL

A. Paints and Finishes: Ready mixed, unless intended to be a field-catalyzed paint.
   1. Provide paints and finishes of a soft paste consistency, capable of being readily and uniformly dispersed to a homogeneous coating, with good flow and brushing properties, and capable of drying or curing free of streaks or sags.
   2. Supply each paint material in quantity required to complete entire project's work from a single production run.
   3. Do not reduce, thin, or dilute paint or finishes or add materials unless such procedure is specifically described in manufacturer's product instructions.

2.03 PAINT SYSTEMS - INTERIOR

A. Paint I-OP - Interior Surfaces to be Painted, Unless Otherwise Indicated: Including gypsum board.
   1. Two top coats and one coat primer.
   2. Top Coat(s): High Performance Architectural Interior Latex; MPI #138, 139, 140, or 141.
      a. Products:
         1) BASIS OF DESIGN: SPEEDHIDE Pro - EV (EGGSHELL)
   3. Top Coat Sheen:
      a. Eggshell: MPI gloss level 3; use this sheen at all locations.
   4. Primer: BASIS OF DESIGN: SPEEDHIDE Pro-EV.

B. Paint I-OP-DF - Dry Fall: Metals; exposed structure and overhead-mounted services in utilitarian spaces, including shop primed steel deck, structural steel, metal fabrications, galvanized ducts, galvanized conduit, and galvanized piping.
   1. Shop primer by others.
   2. One top coat _____.
   3. Top Coat: Alkyd Dry Fall; MPI #55, 89, or 225.
      a. Products:
         1) Basis of Design: PPG Paints Speedhide Alkyd Dry-Fog, 6-161XI, Semi-Gloss.

PART 3 EXECUTION

3.01 PREPARATION

A. Clean surfaces thoroughly and correct defects prior to application.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

C. Remove or mask surface appurtenances, including electrical plates, hardware, light fixture trim, escutcheons, and fittings, prior to preparing surfaces or finishing.

D. Seal surfaces that might cause bleed through or staining of topcoat.

E. Masonry:

F. Concrete Floors and Traffic Surfaces: Remove contamination, acid etch, and rinse floors with clear water. Verify required acid-alkali balance is achieved. Allow to dry.

G. Gypsum Board: Fill minor defects with filler compound. Spot prime defects after repair.

H. Galvanized Surfaces:

I. Ferrous Metal:
   1. Solvent clean according to SSPC-SP 1.
   2. Remove rust, loose mill scale, and other foreign substances using using methods recommended in writing by paint manufacturer and blast cleaning according to SSPC-SP 6 "Commercial Blast Cleaning". Protect from corrosion until coated.

3.02 APPLICATION

A. Remove unfinished louvers, grilles, covers, and access panels on mechanical and electrical components and paint separately.

B. Apply products in accordance with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual".

C. Do not apply finishes to surfaces that are not dry. Allow applied coats to dry before next coat is applied.

D. Apply each coat to uniform appearance in thicknesses specified by manufacturer.

E. Vacuum clean surfaces of loose particles. Use tack cloth to remove dust and particles just prior to applying next coat.

F. Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings removed prior to finishing.

3.03 SCHEDULE - MPI PAINT SYSTEMS

END OF SECTION

SECTION 09 9600 - HIGH-PERFORMANCE COATINGS

PART 2 PRODUCTS

1.01 TOP COAT MATERIALS

A. Coatings - General: Provide complete multi-coat systems formulated and recommended by manufacturer for the applications indicated, in the thicknesses indicated; number of coats specified does not include primer or filler coat.

END OF SECTION

SECTION 09 9723 - CONCRETE AND MASONRY COATINGS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Moisture resistant textured concrete and masonry coatings.

B. Moisture resistant smooth concrete and masonry coatings.

PART 2 PRODUCTS

2.01 MATERIALS

A. Coatings - General: Provide complete systems formulated and recommended by manufacturer for the applications indicated, in the thicknesses indicated.

END OF SECTION

SECTION 10 1400 - SIGNAGE

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Cash allowance for signs.

B. Room and door signs.

C. Interior directional and informational signs.

D. Emergency evacuation maps.

E. Building identification signs.

F. Plaque.

1.02 PRICE AND PAYMENT PROCEDURES

A. See Section 01 2100 - Allowances, for cash allowances affecting this section.

B. Allowance amount covers purchase and delivery but not installation.

1.03 REFERENCE STANDARDS

A. 36 CFR 1191 - Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities; Architectural Barriers Act (ABA) Accessibility Guidelines; current edition.

B. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design; 2010.

C. ICC A117.1 - Accessible and Usable Buildings and Facilities; 2009.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Manufacturer's printed product literature for each type of sign, indicating sign styles, font, foreground and background colors, locations, overall dimensions of each sign.

C. Signage Schedule: Provide information sufficient to completely define each sign for fabrication, including room number, room name, other text to be applied, sign and letter sizes, fonts, and colors.
   1. When room numbers to appear on signs differ from those on drawings, include the drawing room number on schedule.
   2. When content of signs is indicated to be determined later, request such information from Owner through Architect at least 2 months prior to start of fabrication; upon request, submit preliminary schedule.
   3. Submit for approval by Owner through Architect prior to fabrication.

D. Samples: Submit two samples of each type of sign, of size similar to that required for project, illustrating sign style, font, and method of attachment.

E. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. Curved Sign Media Suction Cups: One for each 100 signs; for removing media.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years of documented experience.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Package signs as required to prevent damage before installation.

B. Package room and door signs in sequential order of installation, labeled by floor or building.

C. Store tape adhesive at normal room temperature.

1.07 FIELD CONDITIONS

A. Do not install tape adhesive when ambient temperature is lower than recommended by manufacturer.

B. Maintain this minimum temperature during and after installation of signs.

PART 2 PRODUCTS

2.01 SIGNAGE APPLICATIONS

A. Accessibility Compliance: Signs are required to comply with ADA Standards and ICC A117.1 and applicable building codes, unless otherwise indicated; in the event of conflicting requirements, comply with the most comprehensive and specific requirements.

B. Room and Door Signs: Provide a sign for every doorway, whether it has a door or not, not including corridors, lobbies, and similar open areas. **Unless otherwise noted on plans use the following criteria:**
   1. Sign Type: Flat signs with engraved panel media as specified.
   2. Provide "tactile" signage, with letters raised minimum 1/32 inch and Grade II braille.
   3. Character Height: 1 inch.
   4. Sign Height: 2 inches, unless otherwise indicated.
   5. Office Doors: Identify with room numbers to be determined later, not the numbers indicated on drawings; in addition, provide "window" section for replaceable occupant name.
   6. Conference and Meeting Rooms: Identify with room numbers to be determined later, not the numbers indicated on drawings; in addition, provide "window" section with sliding "In Use/Vacant" indicator.
   7. Service Rooms: Identify with room names and numbers to be determined later, not those indicated on drawings.

8. Rest Rooms: Identify with pictograms, the names "MEN" and "WOMEN", room numbers to be determined later, and braille.

C. Interior Directional and Informational Signs:

D. Emergency Evacuation Maps: (Size to fit 11x17 map. At 4 locations to be identified during the submittal process)
   1. Map content to be provided by Owner.
   2. Use clear plastic panel silk-screened on reverse, in brushed aluminum frame, screw-mounted.

E. Recognition/Donor Panels: Engraved panel media; individual name signs attached with magnetic tape to fixed panel.
   1. Dimensions and Number of Name Signs: As indicated on drawings.
   2. Provide all name signs whether engraved or not, for uniform overall appearance.
   3. Color: Color as selected.

F. Building Identification Signs and seal:
   1. Use individual metal letters.
   2. Mount on outside wall in location indicated on drawings.

G. Plaque: See Allowance for details.

2.02 SIGN TYPES

A. Flat Signs: Signage media without frame.
   1. Edges: Square.
   2. Corners: Square.
   3. Wall Mounting of One-Sided Signs: Tape adhesive.

B. Radius / Curved Signs: One-piece, curved extruded aluminum media holder securing flat, flexible sign media by curved lip on two sides; other two sides closed by end caps; concealed mounting attachment.
   1. Sizes: As indicated on drawings.
   2. Finish: Natural (clear) anodized.
   3. Sign Orientation: Curved in horizontal section.
   4. Wall Mounting of One-Sided Signs: Mechanical anchorage, with predrilled holes, and set in clear silicone sealant.

C. Color and Font: Unless otherwise indicated:
   1. Character Font: Helvetica, Arial, or other sans serif font.
   2. Character Case: Upper case only.
   3. Background Color: Clear.
   4. Character Color: Contrasting color.

2.03 TACTILE SIGNAGE MEDIA

A. Engraved Panels: Laminated colored plastic; engraved through face to expose core as background color:
   1. Total Thickness: 1/16 inch.

2.04 NON-TACTILE SIGNAGE MEDIA

A. Silk Screened Plastic Panels: Letters and graphics silk screened onto reverse side of plastic surface:
   1. Sign Color: Clear.
   2. Total Thickness: 1/8 inch.

2.05 PLAQUES

2.06 DIMENSIONAL LETTERS

A. Metal Letters:
   1. Metal: Aluminum casting.
   2. Finish: Brushed, satin.
   3. Mounting: Concealed screws.

2.07 ACCESSORIES

A. Concealed Screws: Stainless steel, galvanized steel, chrome plated, or other non-corroding metal.

B. Tape Adhesive: Double sided tape, permanent adhesive.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that substrate surfaces are ready to receive work.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install neatly, with horizontal edges level.

C. Protect from damage until Substantial Completion; repair or replace damaged items.

END OF SECTION

SECTION 10 2113.17 - SOLID PHENOLIC TOILET COMPARTMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Solid phenolic toilet compartments, urinal screens, privacy screens including required fittings, hardware, and accessories.

1.02 RELATED REQUIREMENTS

A. Section 06 1000 - Rough Carpentry: Blocking and supports.

B. Section 10 2800 - Toilet, Bath, and Laundry Accessories.

1.03 REFERENCE STANDARDS

A. ASTM A167 - Stainless and Heat Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.

B. ASTM E84 - Surface Burning Characteristics of Building Materials.

C. PS 1 - Structural Plywood; 2009.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination: Coordinate the work with placement of support framing and anchors in walls and ceilings.

1.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Shop Drawings: Indicate partition plan, elevation views, dimensions, details of wall and floor supports, door swings.

C. Product Data: Provide data on panel construction, hardware, and accessories.

D. Samples: Submit two samples of partition panels, 6x6 inch in size illustrating panel finish, color, and sheen.

E. Manufacturer's Installation Instructions: Indicate special procedures, perimeter conditions requiring special attention, and accessibility standards particular to the panel system specified.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Solid Phenolic Toilet Compartments:

1. ASI - Accurate Partitions 8000 Joliet Rd. McCook Ilinois 60525, Tel. 708 442-6800; BASIS OF DESIGN, Alpaco Elegance; www.accuratepartitions.com.

2. Substitutions: Section 01 6000 - Product Requirements.

2.02 MATERIALS

A. Material: Solid phenolic core made of multiple layers of phenolic resin impregnated kraft paper compressed under heat and pressure. Face with high pressure melamine sheet fusion welded to surface of core.
   1. Resistant to delamination, water, steam, corrosion, soaps, detergents, and mildew.
   2. Edges: Black solid phenolic resin, radiused and polished.
   3. Fire hazard: Class B in accordance with ASTM E84 with 35 maximum flame spread and 100 maximum smoke development.

2.03 COMPONENTS

A. Toilet Compartments: floor-mounted headrail-braced.

B. Doors, Panels, and Pilasters: Plastic laminate adhesive and pressure bonded to faces and edges of solid phenolic core, with beveled corners and edges; edges of cut-outs sealed.
   1. Plastic Laminate Color: Custom Color as called out on architectural drawings, satin finish.

C. Door and Panel Dimensions:
   1. Thickness: 1/2 inch.
   2. Door Width: 24 inch.
   3. Door Width for Handicapped Use: 36 inch, out-swinging.
   4. Height: 78 3/4 inch.
   5. Thickness of Pilasters: 1/2 inch.
   6. Height above floor: 6 inches using manufacturers standard pedastals.

D. Urinal Screens: Wall mounted with two panel brackets, and floor-to-ceiling vertical upright consisting of pilaster anchored to floor and ceiling.

2.04 ACCESSORIES

A. Pilaster Shoes: Formed chromed steel with polished finish, 3 inches high, concealing floor fastenings.
   1. Provide adjustment for floor variations with screw jack through steel saddles integral with pilaster.

B. Head Rails: Tubular stainless steel, 1 1/4 inch size, with anti-grip strips and cast socket wall brackets.

C. Wall and Pilaster Brackets: Continuous type, Polished stainless steel.

D. Attachments, Screws, and Bolts: Stainless steel, tamper proof type.
   1. For attaching panels and pilasters to brackets: Through-bolts and nuts; tamper proof.

E. Steel Plate Reinforcement: Carbon steel, prepared for fasteners, 1/8 inch thick.

F. Hardware: Polished stainless steel:
   1. Thumb turn door latch with exterior emergency access feature.

2. Door strike and keeper with rubber bumper; mounted on pilaster in alignment with door latch.
3. Coat hook with rubber bumper; one per compartment, mounted on door.
4. Provide door pull for outswinging doors.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify correct spacing of and between plumbing fixtures.

C. Verify correct location of built-in framing, anchorage, and bracing.

3.02 INSTALLATION

A. Install partitions secure, rigid, plumb, and level in accordance with manufacturer's instructions.

B. Maintain 3/8 to 1/2 inch space between wall and panels and between wall and end pilasters.

C. Attach panel brackets securely to walls using anchor devices.

D. Attach panels and pilasters to brackets.

E. Field touch-up, repair or replace damaged products and finishes prior to substantial completion.

3.03 TOLERANCES

A. Maximum Variation From True Position: 1/4 inch.

B. Maximum Variation From Plumb: 1/8 inch.

3.04 ADJUSTING

A. Adjust and align hardware to uniform clearance at vertical edge of doors, not exceeding 3/16 inch.

B. Adjust adjacent components for consistency of line or plane.

END OF SECTION

SECTION 10 2240 - VERTICALLY FOLDING OPERABLE WALLS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Automatic Vertically Retractable Accoustic Walls

B. Necessary hardware, seals, lifting machinery and electrical controls.

C. Electric operator.

1.02 RELATED REQUIREMENTS

A. Section 05 1000 - Structural Steel: Overhead structural support framing.

B. Section 10 2239 - Folding Panel Partitions: Man door in fold away wall adjacent to Vertically folding operable walls.

C. Section 26 0533.13 - Conduit for Electrical Systems: Empty conduit from partition motor controller to disconnect and from motor controller to control buttons.

1.03 REFERENCE STANDARDS

A. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2016.

B. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements; 2009 (Reapproved 2016).

C. ASTM E413 - Classification for Rating Sound Insulation; 2016.

D. ASTM E557 - Standard Guide for Architectural Design and Installation Practices for Sound Isolation between Spaces Separated by Operable Partitions; 2012.

E. ASTM E596 - Standard Test Method for Laboratory Measurement of Noise Reduction of Sound-Isolating Enclosures; 1996 (Reapproved 2016).

F. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide data on partition materials, operation, hardware and accessories, electric operating components, and colors and finishes available.

C. Shop Drawings: Indicate opening sizes, static and dynamic loads, location and details of pass door and frame, adjacent construction and finish trim, and details of required supports.

D. Samples for Selection: Submit two samples of full manufacturer's color range for selection of colors.

E. Samples for Review: Submit two samples of surface finish, 12 by 12 inches size, illustrating quality, colors selected, texture, and weight.

F. Certificates: Certify that partition system meets or exceeds specified acoustic requirements.

G. Manufacturer's Instructions: Indicate special procedures.

H. Maintenance Data: Include recommended cleaning methods, cleaning materials, and stain removal methods. Describe cleaning materials detrimental to finish surfaces and hardware finish.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified this section with minimum three years of documented experience.

B. The operable wall must be manufactured by a certified ISO-9001-2008 company or an equivalent quality control system.

C. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers of Automatic Vertically Retractable Acoustic Walls:
   1. Skyfold Inc. of Montreal Canada (514) 457-4767, Basis of Design is Skyfold Zenith 48, www.skyfold.com.
   2. Substitutions: See Section 01 6000 - Product Requirements.

2.02 COMPONENTS

A. Fully Automatic Operable Wall: Vertically opening; accordian folding panels; motor operated.
   1. Panel Finish: Fabric from floor to 26.5" and from 79.5" to 132".
   2. Panel Finish: White Marker Board from 26.5" above floor to 79.5" above floor.
   3. Sound Transmission Class (STC): 48-52 calculated in accordance with ASTM E413, based on tests conducted in accordance with ASTM E90, on panel size of 100 sq ft.
   4. Surface Burning Characteristics of Panel Finish: Flame spread/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84.
   5. Installed operable wall system to structure overhead capable of supporting imposed dead load of the wall, with maximum deflection of 1/360 of span.

B. Panel Construction:
   1. Panel Substrate Facing: Steel sheet.
   2. Panels shall be fabricated to be as stiff and flat as possible in order to satisfy the rigid criteria when operable wall is down in closed position and while moving.

C. Core: Structural and extruded aluminum construction utilizing manufacturer's standard fabrication methods.

D. Wall Panel Assembly: thick formed sheet steel frame top, bottom, jambs, and intermediates; welded construction, with acoustical insulation fill.
   1. Thickness without Finish: 11 3/4" inches.
   2. Weight of Assembly: 6.0 Lbs per sq ft not including finishes or motor operator.

E. Acoustic Seals: Retractable acoustic seals at jambs. Flexible acoustic seals at ceilings, floor, and above door to wall enclosure to deck.

2.03 ELECTRICAL CHARACTERISTICS AND COMPONENTS

A. Electrical Characteristics:
   1. 3/4 or 1 hp, 20 amp rated load amperes.
   2. 208 volts, three phase, 60 Hz.

B. Electric Operator: 12 inches per second travelling speed; electromagnetic brake for stopping door due to obstructions or normal operations and a separate dynamic brake for stopping door due to loss of power or catostophic failure of the operating system.

C. Control Station: One standard keyed with constant pressure type push button and one with constant pressure type push button only, 24 volt circuit; recess mounted at opposite ends of door and on opposite sides of wall.
   1. Furnish 4 keys.

D. Conduit and Outlet Boxes: Surface type in accordance with Section 26 0533.13.

E. Wiring Terminations: Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Enclose terminal lugs in terminal box sized to NFPA 70.

F. Disconnect Switch: Factory mount disconnect switch in control panel.

G. Limit Switches: Automatic type, at both extremes of travel, to prevent over-travel.

H. Emergency Release: Mechanism to disengage motor drive system and permit manual operation.

I. Obstruction Sensors: Bottom edge of wall to be equipped with an obstruction sensor that runs the entire length of the wall. Wall shall stop and reverse direction for 3 seconds and stop if obstruction is encountered.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that required utilities are available, of the correct characteristics, in proper location, and ready for use.

C. Verify track supports are laterally braced and will permit track to be level within 1/4 inch of required position and parallel to the floor surface.

D. Verify floor flatness of 1/8 inch in 10 feet, non-cumulative.

3.02 INSTALLATION

A. Install partition in accordance with manufacturer's instructions and ASTM E557.

B. Install electric operator, wiring, and controls. Locate control station(s) as indicated.

C. Fit and align partition assembly and pocket doors level and plumb.

D. Lubricate moving components.

E. Install acoustic sealant to achieve required acoustic performance.

F. Coordinate electrical connections.

3.03 ADJUSTING

A. Visually inspect partition in full extended position for light leaks to identify a potential acoustical leak.

B. Adjust partition assembly to achieve lightproof seal.

3.04 CLEANING

A. Clean finish surfaces and partition accessories.

3.05 CLOSEOUT ACTIVITIES

A. Demonstrate operation of partition and identify potential operational problems.

3.06 SCHEDULES

A. Break Room 1172a/Breakout Conference 1172b: Vertically Retractable Wall, electric operation, floor to ceiling height 10'-0", STC of 48, marker board surface from 26 1/2" to 79 1/2" above floor, fabric surface above and below, both surfaces/sides the same.

B. Conference Room 1173: Vertically Retractable Wall, electric operation, floor to ceiling height 10'-0", STC of 48, marker board surface from 26 1/2" to 79 1/2" above floor, fabric surface above and below, both surfaces/sides the same.

END OF SECTION

SECTION 10 2600 - WALL AND DOOR PROTECTION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Crash rails.

B. Corner guards.

1.02 REFERENCE STANDARDS

A. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design; 2010.

B. ICC A117.1 - Accessible and Usable Buildings and Facilities; 2009.

1.03 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Indicate physical dimensions, features, wall mounting brackets with mounted measurements, anchorage details, and rough-in measurements.

C. Samples: Submit samples illustrating component design, configurations, joinery, color and finish.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Corner Guards:
   1. Babcock-Davis; _____: www.babcockdavis.com/#sle.
   2. Construction Specialties, Inc; BASIS OF DESIGN SMWS-20 (Wood corner guard with stainless steel insert): www.c-sgroup.com/#sle.
   3. Koroseal Interior Products; _____: www.koroseal.com/#sle.

B. Metal Crash Rails (at all briefing rooms, conference rooms, EOC rooms and as indicated in drawings:
   1. Alpar Architectural Products LLC; _____: www.alpararch.com/#sle.
   2. Construction Specialties, Inc; BASIS OF DESIGN: MODEL CRWS-2 : www.c-sgroup.com/#sle.
   3. Inpro; _____: www.inprocorp.com/#sle.

2.02 PRODUCT TYPES

2.03 FABRICATION

A. Fabricate components with tight joints, corners and seams.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that rough openings, concealed blocking, and anchors are correctly sized and located.

B. Verify height of chair back / impact height at each of the rooms to receive crash rails.

C. Verify that substrate surfaces for adhered items are clean and smooth.

D. Start of installation constitutes acceptance of project conditions.

3.02 INSTALLATION

A. Install components in accordance with manufacturer's instructions, level and plumb, secured rigidly in position to supporting construction.

B. Position corner guard 4 inches above finished floor to 72 inches high.

3.03 TOLERANCES

A. Maximum Variation From Required Height: 1/4 inch.

B. Maximum Variation From Level or Plane For Visible Length: 1/4 inch.

3.04 CLEANING

A. Clean wall and door protection items of excess adhesive, dust, dirt, and other contaminants.

END OF SECTION

SECTION 10 2800 - TOILET, BATH, AND LAUNDRY ACCESSORIES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Commercial toilet accessories.

B. Commercial shower and bath accessories.

C. Electric hand/hair dryers.

D. Diaper changing stations.

E. Utility room accessories.

1.02 RELATED REQUIREMENTS

A. Section 08 8300 - Mirrors: Other mirrors.

B. Section 09 3000 - Tiling: Ceramic washroom accessories.

C. Section 10 2113.17 - Solid Phenolic Toilet Compartments.

1.03 REFERENCE STANDARDS

A. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design; 2010.

B. ASTM A269/A269M - Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service; 2015a.

C. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2015.

D. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2015.

E. ASTM C1036 - Standard Specification for Flat Glass; 2016.

F. ASTM C1048 - Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass; 2012.

G. ASTM C1503 - Standard Specification for Silvered Flat Glass Mirror; 2008 (Reapproved 2013).

H. ASTM F2285 - Standard Consumer Safety Performance Specification for Diaper Changing Tables for Commercial Use; 2004, with Editorial Revision (2016).

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordinate the work with the placement of internal wall reinforcement and reinforcement of toilet partitions to receive anchor attachments.

1.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Submit data on accessories describing size, finish, details of function, and attachment methods.

C. Manufacturer's Installation Instructions: Indicate special procedures and conditions requiring special attention.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Commercial Toilet, Shower, and Bath Accessories:
   1. AJW Architectural Products: www.ajw.com.
   2. American Specialties, Inc: www.americanspecialties.com.
   3. Bradley Corporation: www.bradleycorp.com.
   4. Adaptive Access: www.adaptiveaccess.com.
   5. Comfort Designs: www.comfortdesignsbathware.com
   6. Substitutions: Section 01 6000 - Product Requirements.

B. Electric Hand/Hair Dryers:
   1. American Dryer, Inc; ExtremeAir CPC: www.americandryer.com/#sle.
   2. Substitutions: Section 01 6000 - Product Requirements.

C. Diaper Changing Stations:
   1. American Specialties, Inc: www.americanspecialties.com.
   2. Bradley Corporation: www.bradleycorp.com.
   3. Koala Kare Products: www.koalabear.com.
   4. Substitutions: 01 6000 - Product Requirements.

D. All items of each type to be made by the same manufacturer.

2.02 MATERIALS

A. Accessories - General: Shop assembled, free of dents and scratches and packaged complete with anchors and fittings, steel anchor plates, adapters, and anchor components for installation.

B. Keys: Provide FOUR keys for each accessory to Owner; master key lockable accessories.

C. Stainless Steel Sheet: ASTM A666, Type 304.

D. Stainless Steel Tubing: ASTM A269/A269M, Grade TP304 or TP316.

E. Mirror Glass: Tempered safety glass, ASTM C1048; and ASTM C1036 Type I, Class 1, Quality Q2, with silvering as required.

F. Fasteners, Screws, and Bolts: Hot dip galvanized; tamper-proof; security type.

2.03 FINISHES

A. Stainless Steel: Satin finish, unless otherwise noted.

2.04 Commercial Toilet Accessories

A. Toilet Paper Dispenser: Double roll, surface mounted bracket type, stainless steel, spindleless type for tension spring delivery designed to prevent theft of tissue roll.

B. Paper Towel Dispenser: Folded paper type, stainless steel, surface-mounted, with viewing slots on sides as refill indicator and tumbler lock.
   1. Capacity: 300 C-fold minimum.

C. Combination Towel Dispenser/Waste Receptacle: Recessed with projecting waste receptacle, stainless steel; seamless wall flanges, continuous piano hinges.
   1. Waste receptacle liner: Reusable, heavy-duty vinyl.
   2. Towel dispenser capacity: 400 C-fold.
   3. Waste receptacle capacity: 4 gallons.

D. Soap Dispenser: Liquid soap dispenser, deck-mounted on vanity, with polyethylene container concealed below deck; piston and 4 inch spout of stainless steel with bright polished finish; chrome-plated deck escutcheon.
   1. Minimum Capacity: 16 ounces.

E. Soap Dispenser: Liquid soap dispenser, wall-mounted, surface, with stainless steel cover and horizontal stainless steel tank and working parts; push type soap valve, check valve, and window gage refill indicator, tumbler lock.
   1. Minimum Capacity: 48 ounces.

F. Mirrors: Stainless steel framed, 1/4 inch thick tempered safety glass; ASTM C1048.
   1. Size: As indicated in drawings.
   2. Frame: 0.05 inchangle shapes, with mitered and welded and ground corners, and tamperproof hanging system; satin finish.
   3. Backing: Full-mirror sized, minimum 0.03 inch galvanized steel sheet and nonabsorptive filler material.

G. Seat Cover Dispenser: Stainless steel, surface-mounted, reloading by concealed opening at base, tumbler lock.
   1. Minimum capacity: 250 seat covers.

H. Grab Bars: Stainless steel, nonslip grasping surface finish.
   1. Standard Duty Grab Bars:
      a. Push/Pull Point Load: 250 pound-force, minimum.
      b. Dimensions: 1- 1/2 inch inch outside diameter, minimum 0.05 inch wall thickness, exposed flange mounting, 1-1/2 inch clearance between wall and inside of grab bar.
      c. Length and Configuration: As indicated on drawings.
   2. Heavy Duty Grab Bars: Floor supports are acceptable if necessary to achieve load rating. (Used at Bariatric Restrooms and as indicated in drawings)
      a. Push/Pull Point Load: 1000 pound-force, minimum.

b. Dimensions: 1-1/2 inch outside diameter, minimum 0.125 inch wall thickness, exposed flange mounting, 1-1/2 inch clearance between wall and inside of grab bar.
c. Length and Configuration: As indicated on drawings.
d. Products:
1) Conway Bariatric; Heavy Duty Grab Bars: www.conwaybariatric.com/#sle.

I. Combination Sanitary Napkin/Tampon Dispenser: Stainless steel, surface-mounted.
1. Door: Seamless 0.05 inch door with returned edges and tumbler lock.
2. Cabinet: Fully welded, 0.03 inch thick sheet.
3. Operation: 25 cent coin required to operate dispenser. Provide locked coin box, separately keyed.
4. Identify dispensers slots without using brand names.
5. Minimum capacity: 15 napkins and 20 tampons.

J. Sanitary Napkin Disposal Unit: Stainless steel, surface-mounted, self-closing door, locking bottom panel with full-length stainless steel piano-type hinge, removable receptacle.

2.05 Commercial Shower and Bath Accessories

A. Shower Curtain Rod: Stainless steel tube, 1 inch outside diameter, 0.04 inch wall thickness, satin-finished, with 3 inch outside diameter, minimum 0.04 inch thick satin-finished stainless steel flanges, for installation with exposed fasteners.

B. Shower Curtain:
1. Material: Opaque vinyl, 0.008 inch thick, matte finish, with antibacterial treatment, flameproof and stain-resistant.
2. Size: Per shower opening size, coordinate with drawings.
3. Grommets: Stainless steel; pierced through top hem on 6 inch centers.
4. Shower Curtain Hooks: Chrome-plated or stainless steel spring wire designed for snap closure.

C. Folding Shower Seat: Wall-mounted surface; welded tubular seat frame, structural support members, hinges and mechanical fasteners of Type 304 stainless steel, L-shaped, right hand and L-shaped, left hand seat.
1. Seat: Phenolic or polymeric composite one-piece seat or seat slats, of white color.
2. Size: ADA Standards compliant.

D. Wall-Mounted Soap Dish: Heavy duty, seamless stainless steel, surface-mounted with drain holes, without grab bar, satin finish; with concealed mechanical fastening suitable for substrate and backplate.

E. Towel Pin: Stainless steel, 3 inch extension from wall; rectangular-shaped bracket and backplate for concealed attachment, satin finish.

F. Robe Hook: Heavy-duty stainless steel, single-prong, rectangular-shaped bracket and backplate for concealed attachment, satin finish.

2.06 Electric Hand/Hair Dryers

A. Electric Hand Dryers: Traditional fan-in-case type, with downward fixed nozzle.

1. Operation: Automatic, sensor-operated on and off.
2. Mounting: Surface mounted.
3. Cover: Stainless steel with brushed finish.
    a. Tamper-resistant screw attachment of cover to mounting plate.
4. Cold Plasma Generator: Air sanitizing and deodorizing without use of chemicals.
5. Air Velocity: 19,000 linear feet per minute at full power.
6. Fan Control: Field adjustable down to approximately half-speed.
7. Runtime: Field adjustable or automatic, up to 35 seconds.
8. Supply Voltage: As indicated on drawings.
9. Warranty: 5 years.
10. Electric Hand Dryer Products:
    a. American Dryer, Inc; ExtremeAir CPC: www.americandryer.com/#sle.

2.07 Diaper Changing Stations

A. Diaper Changing Station: Wall-mounted folding diaper changing station for use in commercial toilet facilities, meeting or exceeding ASTM F2285.
    1. Material: Polyethylene.
    2. Mounting: Surface.
    3. Color: White.
    4. Minimum Rated Load: 250 pounds.

2.08 Utility Room Accessories

A. Mop and Broom Holder: 0.05 inch thick stainless steel, Type 304, hat-shaped channel.
    1. Holders: 3 spring-loaded rubber cam holders.
    2. Length: 36 inches.

B. Combination Utility Shelf/Mop and Broom Holder: 0.05 inch thick stainless steel, Type 304, with 1/2 inch returned edges, 0.06 inch steel wall brackets.
    1. Drying rod: Stainless steel, 1/4 inch diameter.
    2. Hooks: 2, 0.06 inch stainless steel rag hooks at shelf front.
    3. Mop/broom holders: 3 spring-loaded rubber cam holders at shelf front.
    4. Length: 36 inches.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify exact location of accessories for installation.

C. For electrically-operated accessories, verify that electrical power connections are ready and in the correct locations.

3.02 PREPARATION

A. Deliver inserts and rough-in frames to site for timely installation.

B. Provide templates and rough-in measurements as required.

3.03 INSTALLATION

A. Mounting Heights: As required by accessibility regulations, unless otherwise indicated on drawings or specifications.
   1. Other Accessories: As indicated on drawings.

3.04 PROTECTION

A. Protect installed accessories from damage due to subsequent construction operations.

END OF SECTION

SECTION 10 4400 - FIRE PROTECTION SPECIALTIES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Fire extinguishers.

B. Fire extinguisher cabinets.

C. Accessories.

1.02 RELATED REQUIREMENTS

A. Section 06 1000 - Rough Carpentry: Wood blocking product and execution requirements.

1.03 REFERENCE STANDARDS

A. ASTM E814 - Standard Test Method for Fire Tests of Penetration Firestop Systems; 2013a.

B. FM (AG) - FM Approval Guide; current edition.

C. NFPA 10 - Standard for Portable Fire Extinguishers; 2013.

D. UL (DIR) - Online Certifications Directory; current listings at database.ul.com.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide extinguisher operational features, extinguisher ratings and classifications, color and finish, and anchorage details.

C. Shop Drawings: Indicate locations of cabinets, cabinet physical dimensions, rough-in measurements for recessed cabinets, locations of individual fire extinquishers, mounting measurements for wall bracket, and installation procedures.

D. Manufacturer's Installation Instructions: Indicate special criteria and wall opening coordination requirements.

E. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

F. Maintenance Data: Include test, refill or recharge schedules and re-certification requirements.

1.05 FIELD CONDITIONS

A. Do not install extinguishers when ambient temperature may cause freezing of extinguisher ingredients.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Fire Extinguishers, Cabinets and Accessories:
   1. Ansul, a Tyco Business: www.ansul.com.
   2. JL Industries, Inc: www.jlindustries.com.
   3. Kidde, a unit of United Technologies Corp: www.kidde.com.
   4. Larsen's Manufacturing Co: www.larsensmfg.com.
   5. Nystrom, Inc: www.nystrom.com/sle.
   6. Substitutions: See Section 01 6000 - Product Requirements.

2.02 FIRE EXTINGUISHERS

A. Fire Extinguishers - General: Comply with product requirements of NFPA 10 and applicable codes, whichever is more stringent.
   1. Provide extinguishers labeled by UL (DIR) or FM (AG) for purpose specified and as indicated.

B. Multipurpose Dry Chemical Type Fire Extinguishers: Carbon steel tank, with pressure gauge.
   1. Cartridge Operated: Spun shell.
   2. Class: A:B:C type.
   3. Size: 10 pound.
   4. Finish: Baked polyester powder coat, red color.
   5. Temperature range: Minus 65 degrees F to 140 degrees F.

2.03 FIRE EXTINGUISHER CABINETS

A. Fire Rating: Listed and labeled in accordance with ASTM E814 requirements for fire resistance rating of walls where being installed.

B. Fire Rated Cabinet Construction: One-hour fire rated.

C. Cabinet Configuration: Semi-recessed type.
   1. Size to accommodate accessories.
   2. Trim: Flat rolled edge, with 2 inch wide face.
   3. Projected Trim: Returned to wall surface, with 3 inch projection, and 2 inch wide face.
   4. Provide cabinet enclosure with right angle inside corners and seams, and with formed perimeter trim and door stiles.

D. Door: 0.036 inch metal thickness, reinforced for flatness and rigidity with nylon catch. Hinge doors for 180 degree opening with two butt hinge.

E. Door Handle: Recessed.

F. Door Glazing: Acrylic plastic, clear, 1/8 inch thick, flat shape and set in resilient channel glazing gasket.

G. Cabinet Mounting Hardware: Appropriate to cabinet, with pre-drilled holes for placement of anchors.

H. Finish of Cabinet Exterior Trim and Door: No. 4 - Brushed stainless steel.

I. Finish of Cabinet Interior: White colored enamel.

2.04 ACCESSORIES

A. Extinguisher Brackets: Formed steel, chrome-plated.

B. Cabinet Signage: As selected.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify rough openings for cabinet are correctly sized and located.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install cabinets plumb and level in wall openings, 30 inches from finished floor to inside bottom of cabinet.

C. Place extinguishers in cabinets.

END OF SECTION

SECTION 10 5100 - LOCKERS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Phenolic lockers.

B. Locker benches.

1.02 REFERENCE STANDARDS

A. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2016.

1.03 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Manufacturer's published data on locker construction, sizes and accessories.

C. Shop Drawings: Indicate locker plan layout, numbering plan and combination lock code.

D. Samples: Submit two samples 6 by 6 inches in size, of each color scheduled.

E. Manufacturer's Installation Instructions: Indicate component installation assembly.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Protect locker finish and adjacent surfaces from damage.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Phenolic Lockers:
   1. Columbia Lockers, a division of PSiSC; Phenolic Lockers: www.psisc.com/#sle.
   2. Summit Lockers; Phenolic Lockers: www.summitlockers.com.
   3. Substitutions: See Section 01 6000 - Product Requirements.

2.02 LOCKER APPLICATIONS

A. Staff: Two tier solid phenolic lockers, wall mounted for base indicated on drawings.
   1. Width: 12 inches.
   2. Depth: 18 inches.
   3. Height: 72 inches.
   4. Fittings: Hat shelf, 2 coat hooks.
   5. Locking: Built-in key locks with spring bolt action.
   6. Provide sloped top.

B. Locker Benches: Free standing type; bench top of laminated maple; painted steel pedestals.
   1. Height: 17 inch minimum 19 inch maximum
   2. Length: 42 inches
   3. Depth: 20 inches

2.03 PHENOLIC LOCKERS

A. Lockers: Factory assembled, made of phenolic core panels with mortise and tenon joints and stainless steel mechanical joint fasteners; fully finished inside and out; each locker capable of standing alone.
   1. Doors: Full overlay, covering full width and height of locker body; square edges.
   2. Panel Core Exposed at Edges: Machine polished, without chips or tool marks; square edge unless otherwise indicated.
   3. Where locker ends or sides are exposed, finish the same as fronts or provide extra panels to match fronts.
   4. Ventilation: By holes drilled in tops, bottoms, and intermediate shelves, and by open space between the back of door and locker body.
   5. Provide filler strips where indicated, securely attached to lockers.
   6. Door Color: To be selected by Architect; allow for 2 different colors.
   7. Body Color: Manufacturer's standard white or light color.
   8. Fasteners for Accessories and Locking Mechanisms: Tamperproof type.

B. Component Thicknesses:
   1. Doors: 1/2 inch minimum thickness.
   2. Locker Body: One of the following combinations:
      a. Tops, bottoms, and shelves 3/8 inch; sides and backs 5/16 inch; minimum.
      b. Tops, bottoms, and shelves 1/2 inch; sides 3/8 inch; backs 1/4 inch; minimum.
   3. End Panels and Filler Panels: 1/2 inch minimum thickness.
   4. Sloped Tops: 1/2 inch minimum thickness.

C. Phenolic Core Panels: Nonporous phenolic resin and paper core formed under high pressure, with natural colored finished edges, integral melamine surface, matte finish, and uniform surface appearance; glued laminated panels not acceptable.
   1. Surface Burning Characteristics: Flame spread index of 75 or less, and smoke developed index of 450 or less; when tested in accordance with ASTM E84.

D. Hinges: Stainless steel, satin finish; minimum of 90 degree opening; either exposed barrel 5-knuckle hinge attached to back of door and inside of body with tamperproof screws, or completely concealed cabinetwork style hinge attached with tamperproof screws.

E. Coat Hooks: Stainless steel or reinforced nylon; attached with tamperproof screws.

F. Number Plates: Manufacturer's standard, minimum 4-digit, permanently attached with adhesive; may be field installed.

G. Locks: Locker manufacturer's standard type of style indicated above.

2.04 See drawings for configuration.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that prepared bases are in correct position and configuration.

B. Verify bases are properly sized.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install lockers plumb and square.

C. Place and secure on prepared base.

D. Secure lockers with anchor devices to suit substrate materials. Minimum Pullout Force: 100 lb.

E. Bolt adjoining locker units together to provide rigid installation.

F. Install end panels, filler panels, and sloped tops.

G. Install accessories.

H. Replace components that do not operate smoothly.

3.03 CLEANING

A. Clean locker interiors and exterior surfaces.

END OF SECTION

SECTION 10 7113.43 - FIXED SUN SCREENS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Modular, shop fabricated, extruded aluminum sun screens to be mounted on structure provided by others.

1.02 RELATED REQUIREMENTS

A. Section 05 1200 - Structural Steel Framing: Mounting substrates.

1.03 REFERENCE STANDARDS

A. AAMA 611 - Voluntary Specification for Anodized Architectural Aluminum; 2014 (2015 Errata).

B. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix); 2013.

C. ASTM A307 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength; 2014.

D. ASTM A792/A792M - Standard Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process; 2010 (Reapproved 2015).

E. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2014.

F. ASTM B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric); 2014.

G. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2014.

H. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric); 2013.

I. ASTM F593 - Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs; 2013a.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Shop Drawings: Prior to commencement of fabrication, submit detailed shop drawings, showing all profiles, sections of all components, finishes, fastening details, and manufacturer's technical and descriptive data. Include field dimensions of openings and elevations on shop drawings.

C. Design Data: Submit comprehensive structural analysis of design for the specified loads. Stamp and sign calculations by professional engineer.

D. Samples: 10 inches by 10 inches minimum illustrating design, workmanship and finish color.

E. Specimen Warranty: Furnish a copy of manufacturer's standard warranty.

F. Installer Qualification Statement.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with no less than five years of documented experience.

B. Installer Qualifications: Company specializing in performing the work of this section.
   1. With minimum five years of documented experience.
   2. Approved by manufacturer.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to project site ready for erection.

B. Package using methods that prevent damage during shipping and storage on site.

C. Store materials under cover and elevated above grade.

1.07 WARRANTY

A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.

B. Sun Screens: Correct defective work within a one year period after Date of Substantial Completion.

C. Finish Warranty: Provide manufacturer's one year warranty on factory finish against cracking, peeling, and blistering.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Fixed Sun Screens:
   1. Architectural Grilles & Sunshades, Inc; Airfoils 4"; Bar Tapered; Round Tube Fascia; Kynar finish.: www.agsshade.com/#sle.
   2. DAMS Incorporated: www.damsinc.com/#sle.
   3. Industrial Louvers, Inc: www.industriallouvers.com/#sle.
   4. Metalwerks: www.metalwerksusa.com/#sle.
   5. Substitutions: See Section 01 6000 - Product Requirements.

2.02 SUN SCREENS

A. Sun Screens: Shop fabricated, shop finished, extruded aluminum outriggers, louvers, and fascia, free of defects impairing strength, durability or appearance.
   1. Configuration: As indicated on drawings.
   2. Louver Type: Airfoil.
   3. Outrigger Shape: Wedge.
   4. Design Criteria: Design and fabricate to resist the minimum code required loads without failure, damage, or permanent deflection:
   5. Sizes: As indicated on drawings.
   6. Exposed Aluminum Finish: Class I color anodized.
   7. Provide a complete system ready for erection at project site.
   8. Shop fabricate to the greatest extent possible; disassemble if necessary for shipping.

2.03 MATERIALS

A. Aluminum Extrusions: ASTM B209 (ASTM B209M) or ASTM B221 (ASTM B221M).

B. Aluminum Coated Steel Sheet: ASTM A792/A792M.

C. Concealed Structural Supports: Aluminum, or steel coated for corrosion resistance and dissimilar metal isolation.

D. Fasteners: ASTM F593 stainless steel or ASTM A307 carbon steel.

2.04 FINISHES

A. Class I Color Anodized Finish: AAMA 611 AA-M12C22A42 Integrally colored anodic coating not less than 0.7 mils thick.

B. Superior Performing Organic Coatings: AAMA 2605 multiple coat, thermally cured polyvinylidene fluoride system.

C. Finish Color: As selected by Architect from manufacturer's standard range.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine substrates and site area for conditions that might prevent satisfactory installation.

B. Verify that dimensions of supporting structure are within plus/minus 1/8 inch of dimensions indicated on shop drawings.

C. Verify that all adjacent painting, roofing, masonry work, and other work that might damage sun screen finish has been completed prior to installation of sun screens.

D. Do not install until after all adjacent painting, roofing and masonry have been completed.

E. Do not proceed with installation until all conditions are satisfactory.

3.02 INSTALLATION

A. Install in accordance with manufacturer's installation instructions.

B. Set units level, plumb, with uniform joints, and aligned with building elements.

C. Separate dissimilar metals using concealed bituminous paint or non-absorbent gasket.

D. Anchor units to structure as indicated on drawings.

E. Do not cut or trim aluminum members without approval of manufacturer; do not install damaged members.

F. Touch-up damaged finish coating using material provided by manufacturer to match original coating.

3.03 TOLERANCES

A. Maximum Variation from Level: Plus/Minus 1/8 inch.

3.04 CLEANING

A. Clean exterior surfaces units of dust and debris; follow manufacturer's cleaning instructions for the finish used.

3.05 PROTECTION

A. Protect units after installation to prevent damage due to other work until Date of Substantial Completion.

END OF SECTION

SECTION 10 7500 - FLAGPOLES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Aluminum Flagpoles.

1.02 RELATED REQUIREMENTS

A. Section 03 3000 - Cast-in-Place Concrete: Concrete base and foundation construction.

B. Section 26 0583 - Wiring Connections: Electrical characteristics and wiring connections.

1.03 REFERENCE STANDARDS

A. AASHTO M 36 - Standard Specification for Corrugated Steel Pipe, Metallic-Coated, for Sewers and Drains; 2014.

B. ASTM B241/B241M - Standard Specification for Aluminum and Aluminum-Alloy Seamless Pipe and Seamless Extruded Tube; 2016.

C. NAAMM FP 1001 - Guide Specifications for Design Loads of Metal Flagpoles; 2007.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide data on pole, accessories, and configurations.

C. Shop Drawings: Indicate detailed dimensions, base details, anchor requirements, and imposed loads.

1.05 QUALITY ASSURANCE

A. Designer Qualifications: Design flagpole foundation under direct supervision of a Professional Structural Engineer experienced in design of this Work and licensed the State in which the Project is located.

B. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc., as suitable for the purpose specified and indicated.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Spiral wrap flagpole with protective covering and pack in protective shipping tubes or containers.

B. Protect flagpole and accessories from damage or moisture.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Flagpoles:
   1. American Flagpole: www.americanflagpole.com.
   2. Concord Industries, Inc: www.concordindustries.com.
   3. Pole-Tech Co., Inc: www.poletech.com.
   4. Substitutions: See Section 01 6000 - Product Requirements.

2.02 FLAGPOLES

A. Flagpoles: Designed in accordance with NAAMM FP 1001.
   1. Material: Aluminum.
   2. Design: Straight shaft.
   3. Mounting: Ground mounted type.
   4. Outside Butt Diameter: 8 inches.
   5. Outside Tip Diameter: 4 inches.
   6. Nominal Height: 2 - 30 and 1 - 40 ft poles; measured from nominal ground elevation.
   7. Halyard: External type.

B. Performance Requirements:
   1. Flagpole With Flag Flying: Resistant without permanent deformation to 50 miles/hr wind velocity; non-resonant, safety design factor of 2.5.
   2. Flagpole Without Flag: Resistant without permanent deformation to 75 miles/hr wind velocity; non-resonant, safety design factor of 2.5.

2.03 POLE MATERIALS

A. Aluminum: ASTM B241/B241M, 6063 alloy, T6 temper.

2.04 ACCESSORIES

A. Finial Ball: Stainless steel, 6 inch diameter.

B. Truck Assembly: Cast aluminum; revolving, stainless steel ball bearings, non-fouling.

C. Cleats: 9 inch size, aluminum with galvanized steel fastenings, two per halyard.

D. Cleat Box: Aluminum, with built-in hinge and hasp assembly, attached to pole with tamper proof screws inside box.

E. Halyard: 5/16 inch diameter polypropylene, braided, white.

F. Connecting Sleeve For Multiple Section Poles: Same material as pole, precision fit for field assembly of pole, concealed fasteners.

G. Primer: Zinc chromate type.

2.05 OPERATORS

A. Hand Crank: Removable _____ type.

2.06 MOUNTING COMPONENTS

A. Foundation Tube Sleeve: AASHTO M 36M, corrugated 16 gage, 0.0598 inch steel, galvanized, depth of 42 inches for 30 foot poles and 54 inches for 40 foot pole as indicated on drawings.

B. Pole Base Attachment: Flush; steel base with base cover.

2.07 FINISHING

A. Aluminum: Mill finish.

B. Finial: Spun finish.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that concrete foundation is ready to receive work and dimensions are as indicated on shop drawings.

3.02 PREPARATION

A. Coat metal sleeve surfaces below grade and surfaces in contact with dissimilar materials with asphaltic paint.

3.03 INSTALLATION

A. Install flagpole, base assembly, and fittings in accordance with manufacturer's instructions.

B. Fill foundation tube sleeve with sand specified in Section 31 2323 and compact.

C. Install foundation plate and centering wedges for flagpoles base set in concrete base and fasten.

3.04 TOLERANCES

A. Maximum Variation From Plumb: 1 inch.

3.05 ADJUSTING

A. Adjust operating devices so that halyard and flag function smoothly.

3.06 SCHEDULES

A. Ground Mount Flag Poles: One 40 feet (12.2 m), with U.S. flag, One 30 feet (12.2 m), with State of New Mexico flag and One 30 feet (12.2 m), with Navajo Nation flag.

END OF SECTION

SECTION 11 3012 - APPLIANCES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Kitchen appliances.

B. Laundry appliances.

1.02 RELATED REQUIREMENTS

A. Section 22 1005 - Plumbing Piping: Plumbing connections for appliances.

B. Section 26 0583 - Wiring Connections: Electrical connections for appliances.

1.03 REFERENCE STANDARDS

A. UL (DIR) - Online Certifications Directory; current listings at database.ul.com.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Manufacturer's data indicating dimensions, capacity, and operating features of each piece of residential equipment specified.

C. Copies of Warranties: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years of documented experience.

B. Electric Appliances: Listed and labeled by UL (DIR) and complying with NEMA Standards (National Electrical Manufacturers Association).

1.06 WARRANTY

A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.

B. Provide five (5) year manufacturer warranty on refrigeration system of refrigerators.

C. Provide ten (10) year manufacturer warranty on magnetron tube of microwave ovens.

D. Provide ten (10) year manufacturer warranty on tub and door liner of dishwashers.

PART 2 PRODUCTS

2.01 KITCHEN APPLIANCES

A. Provide Equipment Eligible for Energy Star Rating: Energy Star Rated.

B. Refrigerator, Total of 3 units - Commercial grade for warranty purposes: Free-standing, side-by-side, and frost-free.
   1. Capacity: Total minimum storage of 22 cubic ft; minimum 15 percent freezer capacity.
   2. Energy Usage: Minimum 20 percent more energy efficient than energy efficiency standards set by U.S. Department of Energy (DOE).
   3. Features: Include glass shelves, automatic icemaker, light in freezer compartment, and in-door water and ice dispenser.
   4. Exterior Finish: Stainless steel.
   5. Manufacturers:
      a. Frigidaire Home Products; ____: www.frigidaire.com/#sle.
      b. GE Appliances; ____: www.geappliances.com/#sle.
      c. Whirlpool Corp; ____: www.whirlpool.com/#sle.
      d. Substitutions: See Section 01 6000 - Product Requirements.

C. Refrigerator, Total of 1 units - Commercial grade for warranty purposes: Free-standing, undercounter, and frost-free.
   1. Capacity: Total minimum storage of 5.1 cubic ft; minimum Per model percent freezer capacity.
   2. Energy Usage: Minimum 20 percent more energy efficient than energy efficiency standards set by U.S. Department of Energy (DOE).
   3. Features: Include glass shelves.
   4. Exterior Finish: Stainless steel.
   5. Manufacturers:
      a. Frigidaire Home Products; ____: www.frigidaire.com/#sle.
      b. GE Appliances; ____: www.geappliances.com/#sle.
      c. Whirlpool Corp; ____: www.whirlpool.com/#sle.
      d. Substitutions: See Section 01 6000 - Product Requirements.

D. Range, Total of 3 units: Electric, free-standing, with glass-ceramic cooktop.
   1. Size: 24 inches wide.
   2. Oven: Self-cleaning with electronic ignition.
   3. Elements: Four (4).
   4. Controls: Push-to-turn knobs with analog timer.
   5. Features: Include automatic meat thermometer, storage drawer, oven door window, broiler pan and grid, and oven light.
   6. Exterior Finish: Stainless steel.
   7. Manufacturers:
      a. Frigidaire Home Products; ____: www.frigidaire.com/#sle.
      b. GE Appliances; ____: www.geappliances.com/#sle.
      c. Whirlpool Corp; Basis of Design: Model #WFE500M4HS - ADA Compliant: www.whirlpool.com/#sle.

E. Cooking Exhaust, At all ranges specified above, same manufacturer. Provide ADA compliant controls option.: Range hood.
   1. Size: 30 inches wide.
   2. Fan: Two-speed, 300 cfm
   3. Exhaust: Rectangular, vented to exterior.
   4. Features: Include cooktop light, night light, backdraft damper, removable grease filter, retractable visor, and ____.
   5. Exterior Finish: Painted steel, color as indicated.
   6. Manufacturers:
      a. Frigidaire Home Products; ____: www.frigidaire.com/#sle.
      b. GE Appliances; ____: www.geappliances.com/#sle.
      c. Whirlpool Corp; BASIS OF DESING: Model # GXU7130DXS: www.whirlpool.com/#sle.

F. Microwave, Total of 4 units to be provided: Countertop.
   1. Capacity: 1.3 cubic ft.
   2. Power: 700 watts.
   3. Features: Include turntable, cooktop light, night light, 2-speed exhaust fan, built-in trim kit, and undercabinet mounting kit.
   4. Exterior Finish: Stainless Steel.
   5. Manufacturers:
      a. Frigidaire Home Products: www.frigidaire.com/#sle.
      b. GE Appliances: www.geappliances.com/#sle.
      c. Whirlpool Corp: www.whirlpool.com/#sle.

G. Waste Disposer, Total 4 units: Standard type, overload protection, direct wired, dishwasher connection, drain elbow, drain connector, and sound reduction features.
   1. Power: 1 HP.
   2. Capacity: Large.
   3. Height: 13" inch.
   4. Depth: 9" inch.
   5. Controls: Wall switch.
   6. Voltage: 115 volts, 60 Hz, 4 amps.
   7. Manufacturers:
      a. Insinkerator: Evolution Supreme SS (Basis of design - for under counter clearance)
      b. Frigidaire Home Products: www.frigidaire.com/#sle.
      c. GE Appliances: www.geappliances.com/#sle.
      d. Whirlpool Corp: www.whirlpool.com/#sle.
      e. Substitutions: See Section 01 6000 - Product Requirements.

H. Dishwasher, Total of 3 units: Undercounter. Contractor to coordinate with counter height. Dishwasher to be ADA compatable.
   1. Controls: Solid state electronic.
   2. Wash Levels: Three (3).
   3. Cycles: Six (6), including normal, rinse and hold, short, china/crystal, and pot and pan.
   4. Features: Include rinse aid dispenser, optional no-heat dry, optional water temperature boost, adjustable upper rack, and adjustable lower rack.

5. Finish: Stainless steel.
6. Manufacturers:
    a. Frigidaire Home Products: www.frigidaire.com/#sle.
    b. GE Appliances: www.geappliances.com/#sle.
    c. Whirlpool Corp: www.whirlpool.com/#sle.
    d. Substitutions: See Section 01 6000 - Product Requirements.

2.02 LAUNDRY APPLIANCES (COMMERCIAL)

A. Clothes Washer, BASIS OF DESIGN: SPEED QUEEN: 35LBS WASHER - EXTRACTOR. FOR FIRE FIGHTER / FIRST RESPONDER EQUIPMENT CLEANING.: Front-loading.
    1. Size: 20 LBS Min..
    2. Controls: Solid state electronic.
    3. Cycles: Include normal, permanent press, delicate, soak, automatic soak, and ____.
    4. Motor Speed: Two-speed, four combinations.
    5. Features: Include optional second rinse, bleach dispenser, fabric softener dispenser, self-cleaning lint filter, sound insulation, end of cycle signal, and ____.
    6. Finish: Stainless Steel, color Stainless Steel.
    7. Manufacturers:
        a. Speed Queen / .

B. Clothes Dryer, Type BASIS OF DESIGN: SPEED QUEEN: 35LBS DRYER. FOR FIRE FIGHTER / FIRST RESPONDER EQUIPMENT CLEANING.: Electric, stationary.
    1. Size: Large capacity.
    2. Controls: Solid state electronic, with electronic moisture-sensing dry control.
    3. Temperature Selections: One.
    4. Cycles: Include normal, permanent press, knit/delicate, air only, and ____.
    5. Features: Include interior light, reversible door, stationary rack, sound insulation, end of cycle signal, and ____.
    6. Finish: Painted steel, color as indicated.
    7. Manufacturers:
        a. SPEED QUEEN/.

C. FIREFIGHTER PPE Dryer, Type BASIS OF DESIGN: MILNOR GEAR GUARDIAN FC6. : Electric, stationary.
    1. Size: Large capacity.
    2. Controls: Solid state electronic, with electronic moisture-sensing dry control.
    3. Temperature Selections: One.
    4. Cycles: Include normal, permanent press, knit/delicate, air only, and ____.
    5. Features: Include interior light, reversible door, stationary rack, sound insulation, end of cycle signal, and ____.
    6. Finish: Painted steel, color as indicated.
    7. Manufacturers:
        a. MILNOR GEAR GUARDIAN..

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify utility rough-ins are provided and correctly located.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Anchor built-in equipment in place.

3.03 ADJUSTING

A. Adjust equipment to provide efficient operation.

3.04 CLEANING

A. Remove packing materials from equipment and properly discard.

B. Wash and clean equipment.

END OF SECTION

SECTION 12 3600 - COUNTERTOPS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Countertops for architectural cabinet work.

B. Countertops for manufactured casework.

C. Wall-hung counters and vanity tops.

D. Sinks molded into countertops.

1.02 RELATED REQUIREMENTS

A. Section 06 4100 - Architectural Wood Casework.

B. Section 09 3000 - Tiling: Tile for countertops.

C. Section 22 4000 - Plumbing Fixtures: Faucets and drains for integral Sinks.

1.03 REFERENCE STANDARDS

A. ANSI A208.1 - American National Standard for Particleboard; 2009.

B. ANSI A208.2 - American National Standard for Medium Density Fiberboard for Interior Use; 2009.

C. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2015.

D. ASTM D635 - Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position; 2014.

E. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2016.

F. AWI (QCP) - Quality Certification Program; current edition at www.awiqcp.org.

G. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards; 2014.

H. AWMAC (GIS) - Guarantee and Inspection Services Program; current edition at www.awmac.com/gis.php.

I. IAPMO Z124 - Plastic Plumbing Fixtures; 2017.

J. ISFA 2-01 - Classification and Standards for Solid Surfacing Material; 2013.

K. NEMA LD 3 - High-Pressure Decorative Laminates; 2005.

L. PS 1 - Structural Plywood; 2009.

M. WI (CCP) - Certified Compliance Program (CCP); current edition at www.woodworkinstitute.com.

N. WI (MCP) - Monitored Compliance Program (MCP); current edition at www.woodworkinstitute.com.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Manufacturer's data sheets on each product to be used, including:
   1. Preparation instructions and recommendations.
   2. Storage and handling requirements and recommendations.
   3. Specimen warranty.

C. Shop Drawings: Complete details of materials and installation; combine with shop drawings of cabinets and casework specified in other sections.

D. Selection Samples: For each finish product specified, color chips representing manufacturer's full range of available colors and patterns.

E. Verification Samples: For each finish product specified, minimum size 6 inches square, representing actual product, color, and patterns.

F. Test Reports: Chemical resistance testing, showing compliance with specified requirements.

G. Certificate: Submit labels and certificates required by quality assurance and quality control programs.

H. Installation Instructions: Manufacturer's installation instructions and recommendations.

I. Maintenance Data: Manufacturer's instructions and recommendations for maintenance and repair of countertop surfaces.

1.05 QUALITY ASSURANCE

A. Installer Qualifications: Company specializing in performing work of the type specified in this section, with not less than three years of documented experience.

B. Quality Certification:
   1. Comply with AWI (QCP) woodwork association quality certification service/program in accordance with requirements for work specified in this section: www.awiqcp.org/#sle.
      a. This AWI (QCP) project is registered as project number TBD..
   2. Provide labels or certificates indicating that the installed work complies with AWI/AWMAC/WI (AWS) requirements for grade or grades specified.
   3. Provide designated labels on shop drawings as required by certification program.
   4. Provide designated labels on installed products as required by certification program.
   5. Submit certifications upon completion of installation that verifies this work is in compliance with specified requirements.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Store products in manufacturer's unopened packaging until ready for installation.

B. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.

1.07 FIELD CONDITIONS

A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

PART 2 PRODUCTS

2.01 COUNTERTOPS

A. Quality Standard: Custom Grade, in accordance with AWI/AWMAC/WI (AWS), unless noted otherwise.

B. Plastic Laminate Countertops: High-pressure decorative laminate (HPDL) sheet bonded to substrate.
   1. Laminate Sheet: NEMA LD 3, Grade HGS, for horizontal surfaces,.048 inch nominal thickness.
   2. Laminate Sheet: NEMA LD 3, Grade VGP, for all vertical surfaces, .028 inch nominal thickness.
   3. Laminate Sheet: NEMA LD 3, Grade HGP, for postforming horizontal and vertical surfaces, 039 inch nominal thickness.
      a. Manufacturers:
         1) Formica Corporation; See Interior Material Schedule for Basis of Design Products: www.formica.com/#sle.
         2) Wilsonart; See Interior Material Schedule for Basis of Design Products: www.wilsonart.com.
         3) Lab Designs: See Interior Material Schedule for Basis of Design Products: http://www.labdesignlaminate.com/
         4) Substitutions: See Section 01 6000 - Product Requirements.
      b. Surface Burning Characteristics: Flame spread index of 25, maximum; smoke developed index of 450, maximum; when tested in accordance with ASTM E84.
      c. Wear Resistance: In addition to specified grade, comply with NEMA LD 3 High Wear Grade requirements for wear resistance.
      d. Finish: Matte or suede, gloss rating of 5 to 20.
      e. Surface Color and Pattern: As selected by Architect from the manufacturer's full line.
   4. Exposed Edge Treatment: Postformed laminate; front edge substrate built up to minimum 1-1/4 inch thick with raised radiused edge, integral coved backsplash with radiused top edge.
   5. Back and End Splashes: Same material, same construction.

C. Solid Surfacing Countertops: Solid surfacing sheet or plastic resin casting over continuous substrate.
   1. Flat Sheet Thickness: 1/2 inch, minimum.
   2. Solid Surfacing Sheet and Plastic Resin Castings: Complying with ISFA 2-01 and NEMA LD 3; acrylic or polyester resin, mineral filler, and pigments; homogenous, non-porous and capable of being worked and repaired using standard woodworking tools; no surface coating; color and pattern consistent throughout thickness.
      a. Manufacturers:
         1) Avonite Surfaces: www.avonitesurfaces.com.
         2) Dupont: www.corian.com. -Basis of design: See Model and color in interior material schedule.
         3) Formica Corporation: www.formica.com.
         4) Wilsonart: www.wilsonart.com.
         5) See Interior Material Schedule for Basis of Design Products.
         6) Substitutions: See Section 01 6000 - Product Requirements.
      b. Surface Burning Characteristics: Flame spread index of 25, maximum; smoke developed index of 450, maximum; when tested in accordance with ASTM E84.
      c. Sinks and Bowls: Integral castings; minimum 3/4 inch wall thickness; comply with IAPMO Z124.
      d. Finish on Exposed Surfaces: Matte, gloss rating of 5 to 20.
      e. Color/Pattern Family: Solid color, light colors.
      f. Color and Pattern: As indicated on drawings.
      g. Color and Pattern: As selected by Architect from manufacturer's full line.
   3. Other Components Thickness: 1/2 inch, minimum.
   4. Exposed Edge Treatment: Built up to minimum 1-1/4 inch thick; square edge; use marine edge at sinks.
   5. Back and End Splashes: Same sheet material, square top; minimum 4 inches high.
   6. Skirts: As indicated on drawings.

2.02 ACCESSORY MATERIALS

A. Plywood for Supporting Substrate: PS 1 Exterior Grade, A-C veneer grade, minimum 5-ply; minimum 3/4 inch thick; join lengths using metal splines.

B. Particleboard for Supporting Substrate: ANSI A208.1 Grade 2-M-2, 45 pcf minimum density; minimum 3/4 inch thick; join lengths using metal splines.

C. Medium Density Fiberboard for Supporting Substrate: ANSI A208.2.

D. Adhesives: Chemical resistant waterproof adhesive as recommended by manufacturer of materials being joined.

E. Joint Sealant: Mildew-resistant silicone sealant, COLOR TBD.

F. Metal Brackets and Braces: Traditional Steel Bracket, 2" by 20" x 20", color white.

2.03 FABRICATION

A. Fabricate tops and splashes in the largest sections practicable, with top surface of joints flush.

1. Join lengths of tops using best method recommended by manufacturer.
2. Fabricate to overhang fronts and ends of cabinets 1 inch except where top butts against cabinet or wall.
3. Prepare all cutouts accurately to size; replace tops having improperly dimensioned or unnecessary cutouts or fixture holes.

B. Provide back/end splash wherever counter edge abuts vertical surface unless otherwise indicated.
1. Secure to countertop with concealed fasteners and with contact surfaces set in waterproof glue.
2. Height: 4 inches, unless otherwise indicated.

C. Solid Surfacing: Fabricate tops up to 144 inches long in one piece; join pieces with adhesive sealant in accordance with manufacturer's recommendations and instructions.

D. Wall-Mounted Counters: Provide skirts, aprons, brackets, and braces, finished to match.

PART 3 EXECUTION

3.01 EXAMINATION

A. Do not begin installation until substrates have been properly prepared.

B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

C. Verify that wall surfaces have been finished and mechanical and electrical services and outlets are installed in proper locations.

3.02 PREPARATION

A. Clean surfaces thoroughly prior to installation.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.03 INSTALLATION

A. Securely attach countertops to cabinets using concealed fasteners. Make flat surfaces level; shim where required.

B. Attach plastic laminate countertops using screws with minimum penetration into substrate board of 5/8 inch.

C. Install tile as specified in Section 09 3000.

D. Attach epoxy resin countertops using compatible adhesive.

E. Seal joint between back/end splashes and vertical surfaces.
1. Where applied cove molding is not indicated use specified sealant.

3.04 TOLERANCES

A. Variation From Horizontal: 1/8 inch in 10 feet, maximum.

B. Offset From Wall, Countertops: 1/8 inch maximum; 1/16 inch minimum.

C. Field Joints: 1/8 inch wide, maximum.

3.05 CLEANING

A. Clean countertops surfaces thoroughly.

3.06 PROTECTION

A. Protect installed products until completion of project.

B. Touch-up, repair or replace damaged products before Date of Substantial Completion.

END OF SECTION

SECTION 12 4813 - ENTRANCE FLOOR MATS AND FRAMES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Extruded aluminum entrance floor grilles.

B. Recessed mat frames.

1.02 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide data indicating properties of walk-off surface, component dimensions and recessed frame characteristics.

C. Shop Drawings: Indicate dimensions and details for recessed frame.
   1. For recessed frames located within a dimensionally restricted area, show dimensions of space within which the frame will be installed.

D. Samples: Submit two samples, 6 by 6 inch in size illustrating pattern, color, finish, edging.

E. Maintenance Data: Include cleaning instructions, stain removal procedures.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Entrance Floor Grilles and Gratings:
   1. Nystrom, Inc; Product; AlumaGRIL, Rectangular GV34C-NF: www.nystrom.com/sle.
   2. Mats Inc.; www.matsinc.com
   3. Substitutions: See Section 01 6000 - Product Requirements.

2.02 ENTRANCE FLOOR GRILLES AND GRATINGS

A. Entrance floor Grilles: Basis of Design; AlumaGRIL Rectangular Tread model GV34C-NF by Nystrom Inc.; bolt-thru design with individual aluminum spacers.
   1. Material: Aluminum Alloy.
   2. Panels: Foot Grille to be supplied in panels not to exceed 48” x 48”. One Piece design not allowed. All grille panels to be supplied with individual pre-fabricated, factory-assembled frames.
   3. Rolling Load Capacity: 1,200 lbs per ft2 span.

2.03 FABRICATION

A. Construct recessed mat frames square, tight joints at corners, rigid. Coat surfaces with protective coating where in contact with cementitious materials.

B. Fabricate mats in single unit sizes; fabricate multiple mats where indicated on drawings.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that floor opening for mats are ready to receive work.

3.02 PREPARATION

A. Mats: Verify size of floor recess before fabricating mats.

B. Vacuum clean floor recess.

C. Products must be installed on a flat and level substrate, not more than 1/8 inch in 10 feet out of plumb per ACI 302

D. Examine substrates and floor conditions for compliance with requirements for location, size, recess depth and other conditions affecting installation of the Entrance Floor Grilles and frames

E. Proceed with installation only after all unsatisfactory conditions have been corrected.

3.03 INSTALLATION

A. Install frames to achieve flush plane with finished floor surface.

B. Install walk-off surface in floor recess flush with finish floor after cleaning of finish flooring.

C. Strictly comply with manufacturer’s installation instructions and recommendations. Coordinate installation with adjacent work to ensure proper clearances and to prevent tripping hazards.

D. Shop-fabricate units of floor mat to greatest extent possible in sizes as indicated. Where not indicated otherwise, provide single unit for each mat installation, but do not exceed manufacturer's maximum size recommendation for units intended for removal and cleaning. Where joints in mats are necessary, space symmetrically and away from normal traffic lanes. Miter corner joints in framing elements with hairline joints or provide prefabricated corner units without joints. Where possible, verify sizes by field measurement before shop fabrication.

E. Where indicated for recessed or wall-to-wall applications, provide aluminum framework as recommended by manufacturer.

F. Install frames to comply with the Manufacturer’s written instructions. Install frames level and tightly fitted together to prevent units from bowing, warping, moving or slipping.

G. Install Entrance Floor Grilles to comply with the Manufacturer’s written instructions. Coordinate top of entrance mat surface with doors that swing across the Entrance Floor Grilles to provideclearances under the door.

H. Use all of the lockdowns as provided by the Manufacturer. Ensure that all of the lockdown machine screws are tight, and the Entrance Floor Grilles are level, coplanar with the adjacent floor and obstruction free.

3.04 **PROTECTION**

A. After completing frame installations, provide temporary filler of plywood or fiberboard in Entrance Floor Grille recesses and cover frames with protective flooring. Maintain protection until construction traffic has ended and project is near substantial completion.

B. Install Entrance Floor Grilles when no further wheeled construction traffic will occur and all wet type operations, including painting are complete.

3.05 TOLERANCES

A. Maximum Gap Formed at Recessed Frame From Mat Size: 1/8 inch.

END OF SECTION

SECTION 13 8500
SEISMIC PROTECTION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Seismic protection and restraints for mechanical/electrical equipment and systems.

1.02 PERFORMANCE REQUIREMENTS FOR SEISMIC RESTRAINTS

A. Criteria: Provide seismic restraints for mechanical and electrical systems, components and elements in accordance with International Building Code (IBC) 2015 and ASCE 7-10, “Minimum Design Loads for Buildings and Other Structures.” Include seismic bracing, supports, and attachments.

1. Project Conditions
   Site Class as Defined in the IBC: D
2. S_{DS}, Design Spectral Acceleration at Short Periods: 0.137.
3. S_{D1}, Design Spectral Acceleration at One Second Period: 0.075.
4. Assigned Seismic Risk Category as Defined in the IBC: IV.
5. Component Importance Factor Ip: determine in accordance with ASCE 7 for each component.

B. Design: Design seismic restraints in accordance with stated criteria. Design shall be by a Registered Professional Engineer.

C. Exclusion: Install seismic protection of water pipes for fire protection systems as specified in Section 21 10 00.

D. Exclusion: Install seismic protection of ceilings as specified in section 09 50 00.

1.03 SUBMITTALS

A. Product Data: Submit details including materials, configuration and fastenings for manufactured seismic restraint devices. Submit test data approved by ICBO confirming load capacity.

B. Shop Drawings: Signed and sealed by a qualified professional engineer. Include the following:

1. Seismic-Restraint Details: Detail fabrication, arrangement, locations, spacing and attachment of seismic restraints and snubbers. Show anchorage details.

C. Design Analysis for Seismic Restraints: Submit complete calculations for seismic restraints, stamped by a Registered Professional Engineer.

D. Component Certification: When ASCE 7 requires Component Certification for any particular component, submit manufacturer’s certificate of compliance indicating that the component complies with ASCE 7 requirements.

PART 2 PRODUCTS

2.01 SEISMIC RESTRAINTS

A. Provide seismic restraints of type permitted by IBC and ASCE 7 and in accordance with the Contractor have approved design.

PART 3 EXECUTION

3.01 SEISMIC RESTRAINT INSTALLATION

A. Install seismic restraints in accordance with IBC, ASCE 7 and Contractor’s approved design.

END OF SECTION

SECTION 14 2400 - HYDRAULIC ELEVATORS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Complete hydraulic elevator systems.
   1. Passenger type.

B. Elevator Maintenance Contract.

1.02 RELATED REQUIREMENTS

A. Section 03 3000 - Cast-in-Place Concrete: Includes elevator machine foundation, elevator pit, grouting thresholds, and grouting hoistway entrance frames.

B. Section 05 1200 - Structural Steel Framing: Includes hoistway framing, divider beams, and overhead hoist beams.

C. Section 26 0533.13 - Conduit for Electrical Systems:

D. Section 26 0583 - Wiring Connections:

1.03 REFERENCE STANDARDS

A. 16 CFR 1201 - Safety Standard for Architectural Glazing Materials; current edition.

B. AAMA 611 - Voluntary Specification for Anodized Architectural Aluminum; 2014 (2015 Errata).

C. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design; 2010.

D. AISC 360 - Specification for Structural Steel Buildings; 2016.

E. ANSI Z97.1 - American National Standard for Safety Glazing Materials Used in Buildings - Safety Performance Specifications and Methods of Test; 2015.

F. ASME A17.1 - Safety Code for Elevators and Escalators; 2016.

G. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2014.

H. ASTM A276/A276M - Standard Specification for Stainless Steel Bars and Shapes; 2016a.

I. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2015.

J. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2015.

K. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2014.

L. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric); 2013.

M. ASTM C1048 - Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass; 2012.

N. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2015, with Errata (2016).

O. NEMA MG 1 - Motors and Generators; 2016.

P. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

Q. NFPA 80 - Standard for Fire Doors and Other Opening Protectives; 2016.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate work with other installers to provide conduits necessary for installation of wiring including but not limited to:
      a. Telephone service for machine room.
      b. Elevator pit for lighting and sump pump.
      c. Fire alarm panel from controller cabinet.
   2. Coordinate work with other installers for equipment provisions necessary for proper elevator operation, including but not limited to, the following:

B. Preinstallation Meeting: Convene meeting at least one week prior to start of this work.
   1. Review schedule of installation, proper procedures and conditions, and coordination with related work.
   2. Review use of elevator for construction purposes, hours of use, scheduling of use, cleanliness of car, employment of operator, and maintenance of system.

C. Construction Use of Elevator: Not permitted.

1.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Submit data on following items:
   1. Signal and operating fixtures, operating panels, and indicators.
   2. Car design, dimensions, layout, and components.
   3. Car and hoistway door and frame details.
   4. Electrical characteristics and connection requirements.

C. Shop Drawings: Include appropriate plans, elevations, sections, diagrams, and details on following items:
   1. Elevator Equipment and Machines: Size and location of driving machines, power units, controllers, governors, and other components.
   2. Hoistway Components: Size and location of car guide rails, buffers, jack unit and other components.

3. Rail bracket spacing; maximum loads imposed on guide rails requiring load transfer to building structural framing.
4. Clearances and over-travel of car.
5. Locations in hoistway and machine room of traveling cables and connections for car lighting and telephone.
6. Location and sizes of hoistway and car doors and frames.
7. Electrical characteristics and connection requirements.
8. Indicate arrangement of elevator equipment and allow for clear passage of equipment through access openings.

D. Samples: Submit samples illustrating car interior finishes, car and hoistway door and frame finishes, handrail material and finish, and all other finishes in the form of cut sheets, finish color selection brochures, or samples as required..

E. Testing Agency's Qualification Statement.

F. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

G. Initial Maintenance Contract.

H. Maintenance Contract: Submit proposal to Owner for standard one year continuing maintenance contract agreement in accordance with ASME A17.1 and requirements as indicated, starting on date initial maintenance contract is scheduled to expire.
1. Indicate in proposal the services, obligations, conditions, and terms for agreement period and for renewal options.

I. Operation and Maintenance Data:
1. Parts catalog with complete list of equipment replacement parts; identify each entry with equipment description and identifying code.
2. Operation and maintenance manual.
3. Schematic drawings of equipment and hydraulic piping, and wiring diagrams of installed electrical equipment with list of corresponding symbols to identify markings on machine room and hoistway apparatus.

1.06 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum ten years documented experience.

B. Installer Qualifications: Company specializing in performing the work of this section and approved by elevator equipment manufacturer.

C. Testing Agency Qualifications: Independent firm specializing in performing testing and inspections of type specified in this section.

1.07 WARRANTY

A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.

B. Provide manufacturer's warranty for elevator operating equipment and devices for one year from Date of Substantial Completion.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Basis of Design - Hydraulic Elevators: OTIS ELEVATORS; HYDROFIT 3500# - 125 F.P.M..

B. Other Acceptable Manufacturers - Hydraulic Elevators:
   1. ThyssenKrupp Elevator: www.thyssenkruppelevator.com/#sle.
   2. KONE Elevators: https://www.kone.us/.

C. Substitutions: See Section 01 6000 - Product Requirements.
   1. For any product not identified as Basis of Design, submit information as specified for substitutions.

D. Products other than Basis of Design are subject to compliance with specified requirements and prior approval of Architect. By using products other than Basis of Design, the Contractor accepts responsibility for costs associated with any necessary modifications to related work, including any design fees.

2.02 HYDRAULIC ELEVATORS

A. Hydraulic Passenger Elevator, BASIS OF DESIGN : OTIS HydroFit - 3500# - 125 F.P.M:
   1. Hydraulic Elevator Equipment:
      a. Holeless hydraulic with cylinder mounted within hoistway.
   2. Drive System:
   3. Operation Control Type:
   4. Service Control Type:
      a. Standard service control only.
   5. Interior Car Height: 93 Min. inch.
   6. Electrical Power: Per Manf. Requirements, coordinate with electrical drawings.
   7. Rated Net Capacity: 3500 pounds.
   8. Rated Speed: 125 to 150 feet per minute.
   9. Hoistway Size: As indicated on drawings.
   10. Elevator Pit Depth: 60" / per manf. inch.
   11. Travel Distance: As indicated on drawings.
   12. Number of Stops: As indicated on drawings.
   13. Number of Openings: ____ Front; ____ Rear.
   14. Hydraulic Equipment Location: As indicated on drawings

2.03 COMPONENTS

A. Elevator Equipment:
   1. Motors, Hydraulic Equipment, Controllers, Controls, Buttons, Wiring, Devices, and Indicators: Comply with NFPA 70. Refer to Section 26 0583
   2. Guide Rails, Cables, Buffers, Attachment Brackets and Anchors: Design criteria for components includes safety factors in accordance with applicable requirements of Elevator Code, ASME A17.1.
   3. Buffers:

a. Per Manf.

4. Sump Pump:
   a. If required by code / AHJ shall be included with this submittal. Coordinate with foundation / pit installation as required. Coorinate with electrical for wiring as required.

B. Electrical Equipment:
   1. Motors: NEMA MG 1.
   2. Boxes, Conduit, Wiring, and Devices: As required by NFPA 70. Refer to Sections 26 0533.13 and 26 0583.
   3. Spare Conductors: Provide ten percent in extra conductors and two pairs of shielded audio cables in traveling cables.
   4. If sump pump is required, coordinate requirements with electrical contractor.
   5. Include wiring and connections to elevator devices remote from hoistway and between elevator machine room. Provide additional components and wiring to suit machine room layout. Refer to Section 26 0583.

2.04 PERFORMANCE REQUIREMENTS

A. Regulatory Requirements: Comply with ASME A17.1, applicable local codes, and authorities having jurisdiction (AHJ).

B. Accessibility Requirements: Comply with ADA Standards.

C. Perform structural steel design, fabrication, and installation in accordance with AISC 360.

D. Perform welding of steel in accordance with AWS D1.1/D1.1M.

E. Fabricate and install door and frame assemblies in accordance with NFPA 80 and in compliance with requirements of authorities having jurisdiction.

F. Perform electrical work in accordance with NFPA 70.

2.05 OPERATION CONTROLS

A. Elevator Controls: Provide landing operating panels, landing indicator panels, and Card Access system..
   1. Landing Operating Panels: Metallic type, one for originating "Up" and one for originating "Down" calls, one button only at terminating landings; with illuminating indicators.
   2. Landing Indicator Panels: Illuminating.
   3. Provide Card access system with controls. Ensure programming is compatable with owner card access system.
   4. Comply with ADA Standards for elevator controls.

B. Interconnect elevator control system with building security, fire alarm, card access, smoke alarm, building management control, and all other applicable systems.

C. Door Operation Controls:
   1. Program door control to open doors automatically when car arrives at floor landing.

2. Render "Door Close" button inoperative when car is standing at dispatch landing with doors open.
3. Door Safety Devices: Moveable, retractable safety edges, quiet in operation; equipped with photo-electric light rays.

D. Lobby Monitoring Panel:
1. Locate status indicator and control panel for each individual elevator and group of elevators in dispatch center..
2. Etch face plate markings in panel, and fill with paint of contrasting color.
3. Include direction indicator displaying landing "Up" and "Down" calls registered at each landing floor.
4. Include position and motion display for direction of travel of each elevator. Display appropriate graphic characters on non-glare screen. Indicate position of cars at rest and in motion.
5. Include "Firefighter's Service Switch" that manually recalls each elevator to main floor.

E. Provide "Firefighter's Emergency Operation" in accordance with ASME A17.1, applicable building codes, and authorities having jurisdiction (AHJ).
1. Designated Landing: Main Lobby.

2.06 OPERATION CONTROL TYPE

A. Single Automatic (Push Button) Operation Control: Applies to car in single elevator shaft.
1. Refer to description provided in ASME A17.1.
2. Set system operation so that momentary pressure of landing button dispatches car from other landing to that landing.
3. Allow call registered by momentary pressure of landing button at any time to remain registered until car stops in response to that landing call.
4. If elevator car door is not opened within predetermined period of time after car has stopped at terminal landing allow car to respond to call registered from other landing.

2.07 SERVICE CONTROL TYPE

A. Restricted Access Service Control:
1. Landing Call Lock-out: Provide a key operated switch with key removable from "On" or "Off" position in landing control station that performs the following when activated:
a. Restricts or permits landing call registration for that landing.
b. Causes the elevator to not respond to that landing.
2. Allow "Firefighter's Emergency Operation" to take control priority over "Restricted Access Service Control".

2.08 EMERGENCY POWER

A. Set-up elevator operation to run with building emergency power supply when the normal building power supply fails, and in compliance with ASME A17.1 requirements.

B. Building Emergency Power Supply: Supplied by backup generator; provide elevator system components as required for emergency power characteristics with phase rotation the same as for normal power.

1. Provide transfer switches and auxiliary contacts.
2. Provide battery back up as necessary for continous operation of elevator during transfer to back up generator.
3. Install connections to power feeders.

C. Emergency Lighting: Comply with ASME A17.1 elevator lighting requirements.

D. Provide operational control circuitry for adapting the change from normal to emergency power.

E. Upon transfer to emergency power, advance one elevator at a time to a pre-selected landing, stop car, open doors, disable operating circuits, and hold in standby condition.

2.09 MATERIALS

A. Rolled Steel Sections, Shapes, Rods: ASTM A36/A36M.

B. Sheet Steel: Hot-dipped galvanized steel sheet, ASTM A653/A653M, with G90/Z275 coating.

C. Stainless Steel Sheet: ASTM A666, Type 304; No. 4 Brushed finish unless otherwise indicated.

D. Stainless Steel Bars, Shapes and Moldings: ASTM A276/A276M, Type 304.

E. Extruded Aluminum: ASTM B221 (ASTM B221M), natural anodized finish unless otherwise indicated.

F. Tempered Glass: 3/8 inch minimum thickness, fully tempered in compliance with ASME A17.1, 16 CFR 1201, ANSI Z97.1, and ASTM C1048 tempered glass requirements.

G. Carpet Flooring: As specified in Section 09 6816, Type ___.

2.10 CAR AND HOISTWAY ENTRANCES

A. Elevator, No. ___:
1. Car and Hoistway Entrances, Each Elevator Floor Lobby:
    a. Framed Opening Finish and Material: Brushed stainless steel.
    b. Car Door Material: Stainless steel, with rigid sandwich panel construction.
    c. Hoistway Door Material: Stainless steel, with rigid sandwich panel construction.

2.11 CAR EQUIPMENT AND MATERIALS

A. Elevator Car:
1. Car Operating Panel: Provide main and auxiliary; flush-mounted applied face plate, with illuminated call buttons corresponding to floors served with "Door Open/Door Close" buttons, "Door Open" button, "Door Close" button, alarm button, and _____.
    a. Panel Material: Integral with front return; one per car.
    b. Car Floor Position Indicator: Above door with illuminating position indicators.
    c. Locate alarm button where it is unlikely to be accidentally actuated; not more than 54 inch above car finished floor.
2. Flooring: Carpeting.
3. Wall Base: Recessed stainless steel, 4 inch high.

4. Front Return Panel: Match material of car door.
5. Door Wall: Stainless steel.
6. Hand Rail: Aluminum, at all three sides. Provide open clearance space 1-1/2 inch (38 mm) wide to face of wall.
    a. Round, Metal Tube: 1-1/2 inch diameter.
    b. Aluminum Finish: Clear anodized.
7. Ceiling:
    a. Canopy Ceiling: Stainless steel.
    b. Frame Finish: Color anodized aluminum.

B. Car Accessories:
1. Certificate Frame: Stainless steel frame glazed with tempered glass, and attached with tamper-proof screws.

2.12 FINISHES

A. Clear Anodized Finish: Class I, AAMA 611 AA-M12C22A41 clear anodic coating with electrolytically deposited organic seal; not less than 0.7 mils, 0.0007 inch thick.

B. Color Anodized Finish: Class I, AAMA 611 AA-M12C22A44 electrolytically deposited colored anodic coating not less than 0.7 mils, 0.0007 inch thick.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions before starting this work.

B. Verify that hoistway, pit, and machine room are ready for work of this section.

C. Verify hoistway shaft and openings are of correct size and within tolerance.

D. Verify location and size of machine foundation and position of machine foundation bolts.

E. Verify that electrical power is available and of correct characteristics.

3.02 PREPARATION

A. Arrange for temporary electrical power for installation work and testing of elevator components, and comply with requirements of Section 01 5000 - Temporary Facilities and Controls.

B. Maintain elevator pit excavation free of water.

3.03 INSTALLATION

A. Coordinate this work with installation of hoistway wall construction.

B. Install system components, and connect equipment to building utilities.

C. Provide conduit, electrical boxes, wiring, and accessories. Refer to Sections 26 0533.13 and 26 0583.

D. Install hydraulic piping between cylinder and pump unit.

E. Mount machines, motors, pumps, and _____ on vibration and acoustic isolators.
   1. Place on structural supports and bearing plates.
   2. Securely fasten to building supports.
   3. Prevent lateral displacement.

F. Install hoistway, elevator equipment, and components in accordance with approved shop drawings.

G. Install guide rails to allow for thermal expansion and contraction movement of guide rails.

H. Accurately machine and align guide rails, forming smooth joints with machined splice plates.

I. Install hoistway door sills, frames, and headers in hoistway walls; grout sills in place, set hoistway floor entrances in alignment with car openings, and align plumb with hoistway.

J. Structural Metal Surfaces: Clean surfaces of rust, oil or grease; wipe clean with solvent; prime two coats.

K. Wood Surfaces not Exposed to Public View: Finish with one coat primer; one coat enamel.

L. Adjust equipment for smooth and quiet operation.

3.04 FIELD QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements, for additional requirements.

B. Testing and inspection by regulatory agencies certified in accordance with ASME QEI-1 will be performed at their discretion.

C. Operational Tests:
   1. Perform operational tests in the presence of Owner and Architect.
   2. At an agreed time, and the building occupied with normal building traffic, conduct tests to verify performance.
      a. Furnish event recording of each landing call registrations, time initiated, and response time throughout entire working day.
   3. Set period of time elevator takes to travel between typical floor landings at not more than ____ seconds.
      a. Measure time from moment doors start to close until car has stopped level at next floor landing and doors are opening.

3.05 ADJUSTING

A. Adjust for smooth acceleration and deceleration of car to minimize passenger discomfort.

B. Adjust with automatic floor leveling feature at each floor landing to reach 1/4 inch maximum from flush with sill.

3.06 CLEANING

A. Remove protective coverings from finished surfaces.

B. Clean surfaces and components in accordance with manufacturers written instructions.

3.07 CLOSEOUT ACTIVITIES

A. Demonstrate proper operation of equipment to Owner's designated representative.

B. Training: Train Owner's personnel on cleaning and operation and maintenance of system.
   1. Use operation and maintenance manual as training reference, supplemented with additional training materials as required.
   2. Provide minimum of two hours of training.
   3. Location: At project site, unless noted otherwise.

3.08 PROTECTION

A. Do not permit construction traffic within car after cleaning.

B. Protect installed products until Date of Substantial Completion.

C. Touch-up, repair, or replace damaged products and materials prior to Date of Substantial Completion.

3.09 MAINTENANCE

A. Provide Initial Maintenance Contract of elevator system and components in accordance with ASME A17.1 and requirements as indicated for 3 months from Date of Substantial Completion.

B. Perform maintenance contract services using competent and qualified personnel under the supervision and direct employ of the elevator manufacturer or original installer.

C. Include systematic examination, adjustment, and lubrication of elevator equipment.

D. Perform work without removing cars from use during peak traffic periods.

END OF SECTION

SECTION 21 0500

COMMON WORK RESULTS FOR FIRE SUPPRESSION

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. This Section includes the following:

1. Piping materials and installation instructions common to most piping systems.
2. Mechanical sleeve seals.
3. Sleeves.
4. Escutcheons.
5. Grout.
6. Fire-suppression equipment and piping demolition.
7. Equipment installation requirements common to equipment sections.
8. Painting and finishing.
9. Concrete bases.
10. Supports and anchorages.

1.03 DEFINITIONS

A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.

B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in chases.

E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

F. The following are industry abbreviations for plastic materials:

1. CPVC: Chlorinated polyvinyl chloride plastic.

G. The following are industry abbreviations for rubber materials:

1. EPDM: Ethylene-propylene-diene terpolymer rubber.
2. NBR: Acrylonitrile-butadiene rubber.

1.04 SUBMITTALS

A. Product Data: For the following:

1. Mechanical sleeve seals.
2. Escutcheons.

B. Welding certificates.

1.05 QUALITY ASSURANCE

A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."

B. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."

1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."

2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

C. Electrical Characteristics for Fire-Suppression Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.

B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

1.07 COORDINATION

A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for fire-suppression installations.

B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.

C. Coordinate requirements for access panels and doors for fire-suppression items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 08 Section "Access Doors and Frames."

PART 2 - PRODUCTS

2.01 MANUFACTURERS

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the manufacturers specified.

2. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.02 PIPE, TUBE, AND FITTINGS

A. Refer to individual Division 21 piping Sections for pipe, tube, and fitting materials and joining methods.

B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.03 JOINING MATERIALS

A. Refer to individual Division 21 piping Sections for special joining materials not listed below.

B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.

1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.

   a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.

   b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.

2. AWWA C110, rubber, flat face, 1/8 inch thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.

C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.

D. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.

E. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

F. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAg1, silver alloy for refrigerant piping, unless otherwise indicated.

G. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

H. Solvent Cements for Joining CPVC Plastic Piping: ASTM F 493.

2.04 MECHANICAL SLEEVE SEALS

A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.

1. Available Manufacturers:
    a. Advance Products & Systems, Inc.
    b. Calpico, Inc.
    c. Metraflex Co.
    d. Pipeline Seal and Insulator, Inc.
2. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
3. Pressure Plates: Plastic. Include two for each sealing element.
4. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.05 SLEEVES

A. Galvanized-Steel Sheet: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.

C. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

D. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.
    1. Underdeck Clamp: Clamping ring with set screws.

E. Molded PVC: Permanent, with nailing flange for attaching to wooden forms.

F. PVC Pipe: ASTM D 1785, Schedule 40.

G. Molded PE: Reusable, PE, tapered-cup shaped, and smooth-outer surface with nailing flange for attaching to wooden forms.

2.06 ESCUTCHEONS

A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.

B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished chrome-plated finish.

C. One-Piece, Cast-Brass Type: With set screw.
    1. Finish: Polished chrome-plated.

D. Split-Casting, Cast-Brass Type: With concealed hinge and set screw.
    1. Finish: Polished chrome-plated

E. One-Piece, Stamped-Steel Type: With set screw and chrome-plated finish.

F. Split-Plate, Stamped-Steel Type: With concealed hinge, chrome-plated finish.

G. One-Piece, Floor-Plate Type: Cast-iron floor plate.

H. Split-Casting, Floor-Plate Type: Cast brass with concealed hinge and set screw.

2.07 GROUT

A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.
    1. Characteristics: Post-hardening, volume-adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
    2. Design Mix: 5000-psi, 28-day compressive strength.
    3. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.01 FIRE-SUPPRESSION DEMOLITION

A. Refer to Division 01 Section "Cutting and Patching" and Division 02 Section "Selective Structure Demolition" for general demolition requirements and procedures.

B. Disconnect, demolish, and remove fire-suppression systems, equipment, and components indicated to be removed.

1. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
2. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material.
3. Equipment to Be Removed: Disconnect and cap services and remove equipment.
4. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
5. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.

C. If pipe, insulation, or equipment to remain is damaged in appearance or is unserviceable, remove damaged or unserviceable portions and replace with new products of equal capacity and quality.

3.02 PIPING SYSTEMS - COMMON REQUIREMENTS

A. Install piping according to the following requirements and Division 21 Sections specifying piping systems.

B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.

D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

F. Install piping to permit valve servicing.

G. Install piping at indicated slopes.

H. Install piping free of sags and bends.

I. Install fittings for changes in direction and branch connections.

J. Install piping to allow application of insulation.

K. Select system components with pressure rating equal to or greater than system operating pressure.

L. Install escutcheons for penetrations of walls, ceilings, and floors according to the following:

1. New Piping:
    a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
    b. Chrome-Plated Piping: One-piece, cast-brass type with polished chrome-plated finish.
    c. Insulated Piping: One-piece, stamped-steel type with spring clips.
    d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
    e. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, stamped-steel type.
    f. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
    g. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, stamped-steel type, stamped-steel type and set screw.
    h. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass type with polished chrome-plated finish.
    i. Bare Piping in Unfinished Service Spaces: One-piece, stamped-steel type with concealed hinge and set screw.
    j. Bare Piping in Equipment Rooms: One-piece, cast-brass type.
    k. Bare Piping in Equipment Rooms: One-piece, stamped-steel type with set screw.
    l. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece, floor-plate type.
2. Existing Piping: Use the following:

a. Chrome-Plated Piping: Split-casting, cast-brass type with chrome-plated finish.

b. Insulated Piping: Split-plate, stamped-steel type with concealed exposed hinge and spring clips.

c. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split-casting, cast-brass type with chrome-plated finish.

d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split-plate, stamped-steel type with concealed hinge and spring clips.

e. Bare Piping at Ceiling Penetrations in Finished Spaces: Split-casting, cast-brass type with chrome-plated finish.

f. Bare Piping at Ceiling Penetrations in Finished Spaces: Split-plate, stamped-steel type with concealed hinge and set screw.

g. Bare Piping in Unfinished Service Spaces: Split-casting, cast-brass type with polished chrome-plated rough-brass finish.

h. Bare Piping in Unfinished Service Spaces: Split-plate, stamped-steel type with concealed hinge and set screw or spring clips.

i. Bare Piping in Equipment Rooms: Split-casting, cast-brass type.

j. Bare Piping in Equipment Rooms: Split-plate, stamped-steel type with set screw or spring clips.

k. Bare Piping at Floor Penetrations in Equipment Rooms: Split-casting, floor-plate type.

M. Sleeves are not required for core-drilled holes.

N. Permanent sleeves are not required for holes formed by removable PE sleeves.

O. Install sleeves for pipes passing through concrete and masonry walls and concrete floor and roof slabs.

P. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.

1. Cut sleeves to length for mounting flush with both surfaces.

a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.

2. Install sleeves in new walls and slabs as new walls and slabs are constructed.

3. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:

a. Steel Pipe Sleeves: For pipes smaller than NPS 6.

b. Steel Sheet Sleeves: For pipes NPS 6 and larger, penetrating gypsum-board partitions.

c. Stack Sleeve Fittings: For pipes penetrating floors with membrane waterproofing. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level. Refer to Division 07 Section "Sheet Metal Flashing and Trim" for flashing.

1) Seal space outside of sleeve fittings with grout.

4. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth, and location of joint. Refer to Division 07 Section "Joint Sealants" for materials and installation.

Q. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using 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.

1. Install steel pipe for sleeves smaller than 6 inches in diameter.

2. Install cast-iron "wall pipes" for sleeves 6 inches and larger in diameter.

3. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

R. Underground, Exterior-Wall Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

1. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

S. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 07 Section "Penetration Firestopping" for materials.

T. Verify final equipment locations for roughing-in.

U. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.03 PIPING JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements and Division 21 Sections specifying piping systems.

B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.

E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.

F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.

2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

G. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.

H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

I. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:

1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.

2. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.

J. Plastic Pressure Piping Gasketed Joints: Join according to ASTM D 3139.

3.04 PAINTING

A. Painting of fire-suppression systems, equipment, and components is specified in Division 09 Sections "Interior Painting" and "Exterior Painting."

B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.05 CONCRETE BASES

A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions and according to seismic codes at Project.

1. Construct concrete bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit.

2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of the base.

3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
5. Install anchor bolts to elevations required for proper attachment to supported equipment.
6. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
7. Use 3000-psi 28-day compressive-strength concrete and reinforcement as specified in Division 03 Section "Cast-in-Place Concrete".

3.06 ERECTION OF METAL SUPPORTS AND ANCHORAGES

A. Refer to Division 05 Section "Metal Fabrications" for structural steel.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor fire-suppression materials and equipment.

C. Field Welding: Comply with AWS D1.1.

3.07 ERECTION OF WOOD SUPPORTS AND ANCHORAGES

A. Cut, fit, and place wood grounds, nailers, blocking, and anchorages to support, and anchor fire-suppression materials and equipment.

B. Select fastener sizes that will not penetrate members if opposite side will be exposed to view or will receive finish materials. Tighten connections between members. Install fasteners without splitting wood members.

C. Attach to substrates as required to support applied loads.

3.08 GROUTING

A. Mix and install grout for fire-suppression equipment base bearing surfaces, pump and other equipment base plates, and anchors.

B. Clean surfaces that will come into contact with grout.

C. Provide forms as required for placement of grout.

D. Avoid air entrapment during placement of grout.

E. Place grout, completely filling equipment bases.

F. Place grout on concrete bases and provide smooth bearing surface for equipment.

G. Place grout around anchors.

H. Cure placed grout.

END OF SECTION 21 0500

SECTION 21 1313
WET-PIPE SPRINKLER SYSTEMS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes:

1. Pipes, fittings, and specialties.
2. Fire-protection valves.
3. Fire-department connections.
4. Sprinklers.
5. Excess-pressure pumps.
6. Alarm devices.
7. Manual control stations.
8. Control panels.
9. Pressure gages.

B. Related Sections:

1. Division 21 Section "Fire-Suppression Standpipes" for standpipe piping.

1.03 DEFINITIONS

A. High-Pressure Sprinkler Piping: Wet-pipe sprinkler system piping designed to operate at working pressure higher than standard 175 psig, but not higher than 250 psig.

B. Standard-Pressure Sprinkler Piping: Wet-pipe sprinkler system piping designed to operate at working pressure of 175 psig maximum.

1.04 SYSTEM DESCRIPTIONS

A. Wet-Pipe Sprinkler System: Automatic sprinklers are attached to piping containing water and that is connected to water supply through alarm valve. Water discharges immediately from sprinklers when they are opened. Sprinklers open when heat melts fusible link or destroys frangible device. Hose connections are included if indicated.

B. Deluge Sprinkler System: Open sprinklers are attached to piping connected to water supply through deluge valve. Fire-detection system, in same area as sprinklers, opens valve. Water flows into piping system and discharges from attached sprinklers when valve opens.

1.05 PERFORMANCE REQUIREMENTS

A. Standard-Pressure Piping System Component: Listed for 175-psig minimum working pressure.

B. Delegated Design: Design sprinkler system(s), including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

1. Available fire-hydrant flow test records indicate the following conditions:
    a. Date: <Insert test date>.
    b. Time: <Insert time> [a.m.] [p.m.]
    c. Performed by: <Insert operator's name> of <Insert firm>.
    d. Location of Residual Fire Hydrant R: <Insert location>.
    e. Location of Flow Fire Hydrant F: <Insert location>.

f. Static Pressure at Residual Fire Hydrant R: <Insert psig>.

g. Measured Flow at Flow Fire Hydrant F: <Insert gpm>.

h. Residual Pressure at Residual Fire Hydrant R: <Insert psig>.

C. Sprinkler system design shall be approved by authorities having jurisdiction.

1. Margin of Safety for Available Water Flow and Pressure: 10 percent, including losses through water-service piping, valves, and backflow preventers.

2. Sprinkler Occupancy Hazard Classifications: per NFPA 13

D. Seismic Performance: Sprinkler piping shall withstand the effects of earthquake motions determined according to NFPA 13.

1.06 SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings: For wet-pipe sprinkler systems. Include plans, elevations, sections, details, and attachments to other work.

1. Wiring Diagrams: For power, signal, and control wiring.

C. Delegated-Design Submittal: For sprinkler systems indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

D. Coordination Drawings: Sprinkler systems, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Domestic water piping.

2. Structural members.

3. HVAC ductwork.

4. Cable Trays.

5. HVAC equipment.

6. Items penetrating finished ceiling include the following:

a. Lighting fixtures.

b. Air outlets and inlets.

E. Qualification Data: For qualified Installer

F. Approved Sprinkler Piping Drawings: Working plans, prepared according to NFPA 13, that have been approved by authorities having jurisdiction, including hydraulic calculations if applicable.

G. Welding certificates.

H. Fire-hydrant flow test report.

I. Field Test Reports and Certificates: Indicate and interpret test results for compliance with performance requirements and as described in NFPA 13. Include "Contractor's Material and Test Certificate for Aboveground Piping."

J. Field quality-control reports.

K. Operation and Maintenance Data: For sprinkler specialties to include in emergency, operation, and maintenance manuals.

1.07 QUALITY ASSURANCE

A. Installer Qualifications:

1. Installer's responsibilities include designing, fabricating, and installing sprinkler systems and providing professional engineering services needed to assume engineering responsibility. Base calculations on results of fire-hydrant flow test.

a. Engineering Responsibility: Preparation of working plans, calculations, and field test reports by a qualified professional engineer.

B. Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

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. NFPA Standards: Sprinkler system equipment, specialties, accessories, installation, and testing shall comply with the following:

1. NFPA 13, "Installation of Sprinkler Systems."
2. NFPA 13R, "Installation of Sprinkler Systems in Residential Occupancies up to and Including Four Stories in Height."
3. NFPA 24, "Installation of Private Fire Service Mains and Their Appurtenances."

1.08 PROJECT CONDITIONS

A. Interruption of Existing Sprinkler Service: Do not interrupt sprinkler service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary sprinkler service according to requirements indicated:

1. Notify Architect no fewer than two days in advance of proposed interruption of sprinkler service.
2. Do not proceed with interruption of sprinkler service without Architect's written permission.

1.09 COORDINATION

A. Coordinate layout and installation of sprinklers with other construction that penetrates ceilings, including light fixtures, HVAC equipment, and partition assemblies.

1.010 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Sprinkler Cabinets: Finished, wall-mounted, steel cabinet with hinged cover, and with space for minimum of six spare sprinklers plus sprinkler wrench. Include number of sprinklers required by NFPA 13 and sprinkler wrench. Include separate cabinet with sprinklers and wrench for each type of sprinkler used on Project.

PART 2 - PRODUCTS

2.01 PIPING MATERIALS

A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, and fitting materials, and for joining methods for specific services, service locations, and pipe sizes.

2.02 STEEL PIPE AND FITTINGS

A. Standard Weight, Galvanized and Black-Steel Pipe: ASTM A 53/A 53M, Type E. Pipe ends may be factory or field formed to match joining method.

B. Schedule 30, Galvanized and Black-Steel Pipe: ASTM A 135; ASTM A 795/A 795M, or ASME B36.10M, wrought steel; with wall thickness not less than Schedule 30 and not more than Schedule 40. Pipe ends may be factory or field formed to match joining method.

C. Schedule 10, Black-Steel Pipe: ASTM A 135 or ASTM A 795/A 795M, Schedule 10 in NPS 5 and smaller; and NFPA 13-specified wall thickness in NPS 6 to NPS 10, plain end.

D. Steel Flanges and Flanged Fittings: ASME B16.5, Class 150.

E. Steel Welding Fittings: ASTM A 234/A 234M and ASME B16.9.

F. Grooved-Joint, Steel-Pipe Appurtenances:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Anvil International, Inc.

b. Corcoran Piping System Co.

c. National Fittings, Inc.

d. Shurjoint Piping Products.

e. Tyco Fire & Building Products LP.

f. Victaulic Company.

2. Pressure Rating: 175 psig minimum.

3. Galvanized and Uncoated, Grooved-End Fittings for Steel Piping: ASTM A 47/A 47M, malleable-iron casting or ASTM A 536, ductile-iron casting; with dimensions matching steel pipe.

4. Grooved-End-Pipe Couplings for Steel Piping: AWWA C606 and UL 213, rigid pattern, unless otherwise indicated, for steel-pipe dimensions. Include ferrous housing sections, EPDM-rubber gasket, and bolts and nuts.

G. Steel Pressure-Seal Fittings: UL 213, FM-approved, 175-psig pressure rating with steel housing, rubber O-rings, and pipe stop; for use with fitting manufacturers' pressure-seal tools.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Victaulic Company.

2.03 COPPER TUBE AND FITTINGS

A. Hard Copper Tube: ASTM B 88, Type L and ASTM B 88, Type M water tube, drawn temper.

B. Cast-Copper, Solder-Joint Fittings: ASME B16.18, pressure fittings.

C. Wrought-Copper, Solder-Joint Fittings: ASME B16.22, pressure fittings.

D. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.

E. 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.

F. Copper Pressure-Seal Fittings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Viega; Plumbing & Heating Systems.

2. Standard: UL 213.

3. NPS 2 and Smaller: Wrought-copper fitting with EPDM-rubber O-ring seal in each end.

4. NPS 2-1/2 to NPS 4: Cast-bronze fitting with EPDM-rubber O-ring seal in each end.

G. Grooved-Joint, Copper-Tube Appurtenances:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Anvil International, Inc.

b. Shurjoint Piping Products.

c. Victaulic Company.

2. Grooved-End, Copper Fittings: ASTM B 75, copper tube or ASTM B 584, bronze castings.

3. Grooved-End-Tube Couplings: To fit copper-tube dimensions, with design similar to AWWA C606. Include ferrous housing sections, EPDM-rubber gasket suitable for hot and cold water, and bolts and nuts.

H. Copper-Tube, Extruded-Tee Connections:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    a. T-DRILL Industries Inc.
2. Description: Tee formed in copper tube according to ASTM F 2014.

2.04 PIPING JOINING MATERIALS

A. Pipe-Flange Gasket Materials: AWWA C110, rubber, flat face, 1/8 inch thick ASME B16.21, nonmetallic and asbestos free.
    1. Class 125, Cast-Iron Flanges and Class 150, Bronze Flat-Face Flanges: Full-face gaskets.
    2. Class 250, Cast-Iron Flanges and Class 300, Steel Raised-Face Flanges: Ring-type gaskets.
B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.
C. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.
D. Welding Filler Metals: Comply with AWS D10.12M/D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

2.05 COVER SYSTEM FOR SPRINKLER PIPING

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    1. DecoShield Systems, Inc.
B. Description: System of support brackets and covers made to protect sprinkler piping.
C. Brackets: Glass-reinforced nylon.
D. Covers: Extruded PVC sections of length, shape, and size required for size and routing of CPVC piping.

2.06 LISTED FIRE-PROTECTION VALVES

A. General Requirements:
    1. Valves shall be UL listed or FM approved.
    2. Minimum Pressure Rating for Standard-Pressure Piping: 175 psig.
    3. Minimum Pressure Rating for High-Pressure Piping: 250 psig 300 psig.
B. Ball Valves:
    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 on Drawings comparable product by one of the following:
        a. Anvil International, Inc.
        b. Victaulic Company.
    3. Standard: UL 1091 except with ball instead of disc.
    4. Valves NPS 1-1/2 and Smaller: Bronze body with threaded ends.
    5. Valves NPS 2 and NPS 2-1/2: Bronze body with threaded ends or ductile-iron body with grooved ends.
    6. Valves NPS 3: Ductile-iron body with grooved ends.
C. Bronze Butterfly Valves:
    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 on Drawings or comparable product by one of the following:
    a. Fivalco Inc.
    b. Global Safety Products, Inc.
    c. Milwaukee Valve Company.
3. Standard: UL 1091.
4. Pressure Rating: 175 psig.
5. Body Material: Bronze.
6. End Connections: Threaded.

D. Iron Butterfly Valves:
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 on Drawings or comparable product by one of the following:
    a. Anvil International, Inc.
    b. Fivalco Inc.
    c. Global Safety Products, Inc.
    d. Kennedy Valve; a division of McWane, Inc.
    e. Milwaukee Valve Company.
    f. NIBCO INC.
    g. Pratt, Henry Company.
    h. Shurjoint Piping Products.
    i. Tyco Fire & Building Products LP.
    j. Victaulic Company.
3. Standard: UL 1091.
4. Pressure Rating: 175 psig.
5. Body Material: Cast or ductile iron.
6. Style: Lug or wafer.
7. End Connections: Grooved.

E. Check Valves:
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 on Drawings comparable product by one of the following:
    a. AFAC Inc.
    b. American Cast Iron Pipe Company; Waterous Company Subsidiary.
    c. Anvil International, Inc.
    d. Clow Valve Company; a division of McWane, Inc.
    e. Crane Co.; Crane Valve Group; Crane Valves.
    f. Crane Co.; Crane Valve Group; Jenkins Valves.
    g. Crane Co.; Crane Valve Group; Stockham Division.
    h. Fire-End & Croker Corporation.
    i. Fire Protection Products, Inc.

j. Fivalco Inc.
k. Globe Fire Sprinkler Corporation.
l. Groeniger & Company.
m. Kennedy Valve; a division of McWane, Inc.
n. Matco-Norca.
o. Metraflex, Inc.
p. Milwaukee Valve Company.
q. Mueller Co.; Water Products Division.
r. NIBCO INC.
s. Potter Roemer.
t. Reliable Automatic Sprinkler Co., Inc.
u. Shurjoint Piping Products.
v. Tyco Fire & Building Products LP.
w. United Brass Works, Inc.
x. Venus Fire Protection Ltd.
y. Victaulic Company.
z. Viking Corporation.
aa. Watts Water Technologies, Inc.

3. Standard: UL 312.
4. Pressure Rating: 250 psig minimum 300 psig.
5. Type: Swing check.
6. Body Material: Cast iron.
7. End Connections: Flanged or grooved.

F. Bronze OS&Y Gate Valves:

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 on Drawings product by one of the following:
   a. Crane Co.; Crane Valve Group; Crane Valves.
   b. Crane Co.; Crane Valve Group; Stockham Division.
   c. Milwaukee Valve Company.
   d. NIBCO INC.
   e. United Brass Works, Inc.
3. Standard: UL 262.
4. Pressure Rating: 175 psig.
5. Body Material: Bronze.
6. End Connections: Threaded.

G. Iron OS&Y Gate Valves:

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 on Drawings or comparable product by one of the following:
   a. American Cast Iron Pipe Company; Waterous Company Subsidiary.

b. American Valve, Inc.
c. Clow Valve Company; a division of McWane, Inc.
d. Crane Co.; Crane Valve Group; Crane Valves.
e. Crane Co.; Crane Valve Group; Jenkins Valves.
f. Crane Co.; Crane Valve Group; Stockham Division.
g. Hammond Valve.
h. Milwaukee Valve Company.
i. Mueller Co.; Water Products Division.
j. NIBCO INC.
k. Shurjoint Piping Products.
l. Tyco Fire & Building Products LP.
m. United Brass Works, Inc.
n. Watts Water Technologies, Inc.

3. Standard: UL 262.
4. Pressure Rating: 250 psig minimum 300 psig.
5. Body Material: Cast or ductile iron.
6. End Connections: Flanged or grooved.

H. Indicating-Type Butterfly Valves:

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 on Drawings or comparable product by one of the following:
   a. Anvil International, Inc.
   b. Fivalco Inc.
   c. Global Safety Products, Inc.
   d. Kennedy Valve; a division of McWane, Inc.
   e. Milwaukee Valve Company.
   f. NIBCO INC.
   g. Shurjoint Piping Products.
   h. Tyco Fire & Building Products LP.
   i. Victaulic Company.
3. Standard: UL 1091.
4. Pressure Rating: 175 psig minimum.
5. Valves NPS 2 and Smaller:
   a. Valve Type: Ball or butterfly.
   b. Body Material: Bronze.
   c. End Connections: Threaded.
6. Valves NPS 2-1/2 and Larger:
   a. Valve Type: Butterfly.
   b. Body Material: Cast or ductile iron.
   c. End Connections: Flanged, grooved, or wafer.

7. Valve Operation: Integral electrical, 115-V ac, prewired, single-circuit, supervisory switch indicating device.

I. NRS Gate Valves:

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 on Drawings or comparable product by one of the following:
    a. American Cast Iron Pipe Company; Waterous Company Subsidiary.
    b. American Valve, Inc.
    c. Clow Valve Company; a division of McWane, Inc.
    d. Crane Co.; Crane Valve Group; Stockham Division.
    e. Kennedy Valve; a division of McWane, Inc.
    f. Mueller Co.; Water Products Division.
    g. NIBCO INC.
    h. Tyco Fire & Building Products LP.
3. Standard: UL 262.
4. Pressure Rating: 250 psig minimum 300 psig.
5. Body Material: Cast iron with indicator post flange.
6. Stem: Nonrising.
7. End Connections: Flanged or grooved.

J. Indicator Posts:

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 on Drawings comparable product by one of the following:
    a. American Cast Iron Pipe Company; Waterous Company Subsidiary.
    b. American Valve, Inc.
    c. Clow Valve Company; a division of McWane, Inc.
    d. Crane Co.; Crane Valve Group; Stockham Division.
    e. Kennedy Valve; a division of McWane, Inc.
    f. Mueller Co.; Water Products Division.
    g. NIBCO INC.
    h. Tyco Fire & Building Products LP.
3. Standard: UL 789.
4. Type: Horizontal for wall mounting.
5. Body Material: Cast iron with extension rod and locking device.
6. Operation: Wrench.

2.07 TRIM AND DRAIN VALVES

A. General Requirements:

1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
2. Pressure Rating: 175 psig minimum.

B. Angle Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    a. Fire Protection Products, Inc.
    b. United Brass Works, Inc.

C. Ball Valves:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    a. Affiliated Distributors.
    b. Anvil International, Inc.
    c. Barnett.
    d. Conbraco Industries, Inc.; Apollo Valves.
    e. Fire-End & Croker Corporation.
    f. Fire Protection Products, Inc.
    g. Flowserve.
    h. FNW.
    i. Jomar International, Ltd.
    j. Kennedy Valve; a division of McWane, Inc.
    k. Kitz Corporation.
    l. Legend Valve.
    m. Metso Automation USA Inc.
    n. Milwaukee Valve Company.
    o. NIBCO INC.
    p. Potter Roemer.
    q. Red-White Valve Corporation.
    r. Southern Manufacturing Group.
    s. Stewart, M. A. and Sons Ltd.
    t. Tyco Fire & Building Products LP.
    u. Victaulic Company.
    v. Watts Water Technologies, Inc.

D. Globe Valves:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    a. Fire Protection Products, Inc.
    b. United Brass Works, Inc.
    c.

E. Plug Valves:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    a. Southern Manufacturing Group.

2.08 SPECIALTY VALVES

A. General Requirements:
1. Standard: UL's "Fire Protection Equipment Directory"listing or "Approval Guide," published by FM Global, listing.

2. Pressure Rating:
    a. Standard-Pressure Piping Specialty Valves: 175 psig minimum.
    b. High-Pressure Piping Specialty Valves: 250 psig minimum 300 psig.
3. Body Material: Cast or ductile iron.
4. Size: Same as connected piping.
5. End Connections: Flanged or grooved.

B. Alarm Valves:
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 on Drawings or comparable product by one of the following:
    a. AFAC Inc.
    b. Globe Fire Sprinkler Corporation.
    c. Reliable Automatic Sprinkler Co., Inc.
    d. Tyco Fire & Building Products LP.
    e. Venus Fire Protection Ltd.
    f. Victaulic Company.
    g. Viking Corporation.
3. Standard: UL 193.
4. Design: For horizontal or vertical installation.
5. Include trim sets for bypass, drain, electrical sprinkler alarm switch, pressure gages, retarding chamber, and fill-line attachment with strainer.
6. Drip Cup Assembly: Pipe drain without valves and separate from main drain piping.
7. Drip Cup Assembly: Pipe drain with check valve to main drain piping.

C. Deluge Valves:
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 on Drawings or comparable product by one of the following:
    a. AFAC Inc.
    b. BERMAD Control Valves.
    c. CLA-VAL Automatic Control Valves.
    d. Globe Fire Sprinkler Corporation.
    e. OCV Control Valves.
    f. Reliable Automatic Sprinkler Co., Inc.
    g. Tyco Fire & Building Products LP.
    h. Venus Fire Protection Ltd.
    i. Victaulic Company.
    j. Viking Corporation.
3. Standard: UL 260.
4. Design: Hydraulically operated, differential-pressure type.

5. Include trim sets for bypass, drain, electrical sprinkler alarm switch, pressure gages, drip cup assembly piped without valves and separate from main drain line, fill-line attachment with strainer, and push-rod chamber supply connection.
6. Wet, Pilot-Line Trim Set: Include gage to read push-rod chamber pressure, globe valve for manual operation of deluge valve, and connection for actuation device.

D. Automatic Ball Drip Drain Valves:
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 on Drawings or comparable product by one of the following:
   a. AFAC Inc.
   b. Reliable Automatic Sprinkler Co., Inc.
   c. Tyco Fire & Building Products LP.
3. Standard: UL 1726.
4. Pressure Rating: 175 psig minimum.
5. Type: Automatic draining, ball check.
6. Size: NPS 3/4.
7. End Connections: Threaded.

2.09 FIRE-DEPARTMENT CONNECTIONS

A. Exposed-Type, Fire-Department Connection:
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 on Drawings or comparable product by one of the following:
   a. AFAC Inc.
   b. Elkhart Brass Mfg. Company, Inc.
   c. Fire-End & Croker Corporation.
   d. Fire Protection Products, Inc.
   e. GMR International Equipment Corporation.
   f. Guardian Fire Equipment, Inc.
   g. Tyco Fire & Building Products LP.
   h. Wilson & Cousins Inc.
3. Standard: UL 405.
4. Type: Exposed, projecting, for wall mounting.
5. Pressure Rating: 175 psig minimum.
6. Body Material: Corrosion-resistant metal.
7. Inlets: Brass with threads according to NFPA 1963 and matching local fire-department sizes and threads. Include extension pipe nipples, brass lugged swivel connections, and check devices or clappers.
8. Caps: Brass, lugged type, with gasket and chain.
9. Escutcheon Plate: Round, brass, wall type.
10. Outlet: Back, with pipe threads.
11. Number of Inlets: Two.
12. Escutcheon Plate Marking: Similar to "AUTO SPKR & STANDPIPE."

13. Finish: Rough brass or bronze.
14. Outlet Size: NPS 4, NPS 5, NPS 6.

B. Flush-Type, Fire-Department Connection:
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 on Drawings or comparable product by one of the following:
a. AFAC Inc.
b. Elkhart Brass Mfg. Company, Inc.
c. GMR International Equipment Corporation.
d. Guardian Fire Equipment, Inc.
e. Potter Roemer.
3. Standard: UL 405.
4. Type: Flush, for wall mounting.
5. Pressure Rating: 175 psig minimum.
6. Body Material: Corrosion-resistant metal.
7. Inlets: Brass with threads according to NFPA 1963 and matching local fire-department sizes and threads. Include extension pipe nipples, brass lugged swivel connections, and check devices or clappers.
8. Caps: Brass, lugged type, with gasket and chain.
9. Escutcheon Plate: Rectangular, brass, wall type.
10. Outlet: With pipe threads.
11. Body Style: Horizontal.
12. Number of Inlets: Two.
13. Outlet Location: See Drawings.
14. Escutcheon Plate Marking: Similar to "AUTO SPKR & STANDPIPE."
15. Finish: Rough brass or bronze.
16. Outlet Size: NPS 4, NPS 5, NPS 6, NPS 8.

C. Yard-Type, Fire-Department Connection:
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 on Drawings or comparable product by one of the following:
a. AFAC Inc.
b. Elkhart Brass Mfg. Company, Inc.
c. Fire-End & Croker Corporation.
d. Fire Protection Products, Inc.
e. GMR International Equipment Corporation.
f. Guardian Fire Equipment, Inc.
g. Wilson & Cousins Inc.
3. Standard: UL 405.
4. Type: Exposed, freestanding.
5. Pressure Rating: 175 psig minimum 300 psig.

6. Body Material: Corrosion-resistant metal.
7. Inlets: Brass with threads according to NFPA 1963 and matching local fire-department sizes and threads. Include extension pipe nipples, brass lugged swivel connections, and check devices or clappers.
8. Caps: Brass, lugged type, with gasket and chain.
9. Escutcheon Plate: Round, brass, floor type.
10. Outlet: Bottom, with pipe threads.
11. Number of Inlets: Two.
12. Sleeve: Brass.
13. Sleeve Height: 18 inches.
14. Escutcheon Plate Marking: Similar to "AUTO SPKR & STANDPIPE."
15. Finish Rough brass or bronze.
16. Outlet Size: NPS 4, NPS 5, NPS 6.

2.010 SPRINKLER SPECIALTY PIPE FITTINGS

A. Branch Outlet Fittings:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following
   a. Anvil International, Inc.
   b. National Fittings, Inc.
   c. Shurjoint Piping Products.
   d. Tyco Fire & Building Products LP.
   e. Victaulic Company.
2. Standard: UL 213.
3. Pressure Rating: 175 psig minimum 300 psig
4. Body Material: Ductile-iron housing with EPDM seals and bolts and nuts.
5. Type: Mechanical-T and -cross fittings.
6. Configurations: Snap-on and strapless, ductile-iron housing with branch outlets.
7. Size: Of dimension to fit onto sprinkler main and with outlet connections as required to match connected branch piping.
8. Branch Outlets: Grooved, plain-end pipe, or threaded.

B. Flow Detection and Test Assemblies:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. AGF Manufacturing Inc.
   b. Reliable Automatic Sprinkler Co., Inc.
   c. Tyco Fire & Building Products LP.
   d. Victaulic Company.
2. Standard: UL's "Fire Protection Equipment Directory "listing or "Approval Guide," published by FM Global, listing.
3. Pressure Rating: 175 psig minimum 300 psig.
4. Body Material: Cast- or ductile-iron housing with orifice, sight glass, and integral test valve.
5. Size: Same as connected piping.

6. Inlet and Outlet: Threaded.

C. Branch Line Testers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Elkhart Brass Mfg. Company, Inc.
   b. Fire-End & Croker Corporation.
   c. Potter Roemer.
2. Standard: UL 199.
3. Pressure Rating: 175 psig
4. Body Material: Brass.
5. Size: Same as connected piping.
6. Inlet: Threaded.
7. Drain Outlet: Threaded and capped.
8. Branch Outlet: Threaded, for sprinkler.

D. Sprinkler Inspector's Test Fittings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. AGF Manufacturing Inc.
   b. Triple R Specialty.
   c. Tyco Fire & Building Products LP.
   d. Victaulic Company.
   e. Viking Corporation.
2. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
3. Pressure Rating: 175 psig minimum 300 psig.
4. Body Material: Cast- or ductile-iron housing with sight glass.
5. Size: Same as connected piping.
6. Inlet and Outlet: Threaded.

E. Adjustable Drop Nipples:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. CECA, LLC.
   b. Corcoran Piping System Co.
   c. Merit Manufacturing; a division of Anvil International, Inc.
2. Standard: UL 1474.
3. Pressure Rating: 250 psig minimum 300 psig.
4. Body Material: Steel pipe with EPDM-rubber O-ring seals.
5. Size: Same as connected piping.
6. Length: Adjustable.
7. Inlet and Outlet: Threaded.

F. Flexible, Sprinkler Hose Fittings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Fivalco Inc.

b. FlexHead Industries, Inc.

2. Standard: UL 1474.

3. Type: Flexible hose for connection to sprinkler, and with bracket for connection to ceiling grid.

4. Pressure Rating: 175 psig minimum 300 psig.

5. Size: Same as connected piping, for sprinkler.

2.011 SPRINKLERS

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

1. AFAC Inc.

2. Globe Fire Sprinkler Corporation.

3. Reliable Automatic Sprinkler Co., Inc.

4. Tyco Fire & Building Products LP.

5. Venus Fire Protection Ltd.

6. Victaulic Company.

7. Viking Corporation.

B. General Requirements:

1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.

2. Pressure Rating for Residential Sprinklers: 175 psig maximum.

3. Pressure Rating for Automatic Sprinklers: 175 psig minimum.

4. Pressure Rating for High-Pressure Automatic Sprinklers: 250 psig minimum 300 psig.

C. Automatic Sprinklers with Heat-Responsive Element:

1. Early-Suppression, Fast-Response Applications: UL 1767.

2. Nonresidential Applications: UL 199

3. Residential Applications: UL 1626

4. Characteristics: Nominal 1/2-inch orifice with Discharge Coefficient K of 5.6, and for "Ordinary" temperature classification rating unless otherwise indicated or required by application.

D. Open Sprinklers with Heat-Responsive Element Removed: UL 199.

1. Characteristics:

a. Nominal 1/2-inch Orifice: With Discharge Coefficient K between 5.3 and 5.8

b. Nominal 17/32-inch Orifice: With Discharge Coefficient K between 7.4 and 8.2

E. Sprinkler Finishes:

1. Chrome plated.

2. Bronze.

3. Painted.

F. Special Coatings:

1. Wax.

2. Lead.

3. Corrosion-resistant paint.

G. Sprinkler Escutcheons: Materials, types, and finishes for the following sprinkler mounting applications. Escutcheons for concealed, flush, and recessed-type sprinklers are specified with sprinklers.

1. Ceiling Mounting: Chrome-plated steel, one piece, flat
2. Sidewall Mounting: Chrome-plated steel, one piece, flat.

H. Sprinkler Guards:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following
   a. Reliable Automatic Sprinkler Co., Inc.
   b. Tyco Fire & Building Products LP.
   c. Victaulic Company.
   d. Viking Corporation.
2. Standard: UL 199.
3. Type: Wire cage with fastening device for attaching to sprinkler.

2.012 ALARM DEVICES

A. Alarm-device types shall match piping and equipment connections.

B. Water-Motor-Operated Alarm:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Globe Fire Sprinkler Corporation.
   b. Tyco Fire & Building Products LP.
   c. Victaulic Company.
   d. Viking Corporation.
2. Standard: UL 753.
3. Type: Mechanically operated, with Pelton wheel.
4. Alarm Gong: Cast aluminum with red-enamel factory finish.
5. Size: 10-inch diameter.
6. Components: Shaft length, bearings, and sleeve to suit wall construction.
7. Inlet: NPS 3/4.
8. Outlet: NPS 1 drain connection.

C. Electrically Operated Alarm Bell:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Fire-Lite Alarms, Inc.; a Honeywell company.
   b. Notifier; a Honeywell company.
   c. Potter Electric Signal Company.
2. Standard: UL 464.
3. Type: Vibrating, metal alarm bell.
4. Size: 6-inch minimum 8-inch minimum 10-inch diameter.
5. Finish: Red-enamel factory finish, suitable for outdoor use.

D. Water-Flow Indicators:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following :

a. ADT Security Services, Inc.
b. McDonnell & Miller; ITT Industries.
c. Potter Electric Signal Company.
d. System Sensor; a Honeywell company.
e. Viking Corporation.
f. Watts Industries (Canada) Inc.

2. Standard: UL 346.
3. Water-Flow Detector: Electrically supervised.
4. Components: 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.
5. Type: Paddle operated.
6. Pressure Rating: 250 psig.
7. Design Installation: Horizontal or vertical.

E. Pressure Switches:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following :
a. AFAC Inc.
b. Barksdale, Inc.
c. Detroit Switch, Inc.
d. Potter Electric Signal Company.
e. System Sensor; a Honeywell company.
f. Tyco Fire & Building Products LP.
g. United Electric Controls Co.
h. Viking Corporation.
2. Standard: UL 346.
3. Type: Electrically supervised water-flow switch with retard feature.
4. Components: Single-pole, double-throw switch with normally closed contacts.
5. Design Operation: Rising pressure signals water flow.

F. Valve Supervisory Switches:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following :
a. Fire-Lite Alarms, Inc.; a Honeywell company.
b. Kennedy Valve; a division of McWane, Inc.
c. Potter Electric Signal Company.
d. System Sensor; a Honeywell company.
2. Standard: UL 346.
3. Type: Electrically supervised.
4. Components: Single-pole, double-throw switch with normally closed contacts.
5. Design: Signals that controlled valve is in other than fully open position.

G. Indicator-Post Supervisory Switches:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following :
    a. Potter Electric Signal Company.
    b. System Sensor; a Honeywell company.
2. Standard: UL 346.
3. Type: Electrically supervised.
4. Components: Single-pole, double-throw switch with normally closed contacts.
5. Design: Signals that controlled indicator-post valve is in other than fully open position.

2.013 MANUAL CONTROL STATIONS

A. Description: UL listed or FM approved, hydraulic operation, with union, NPS 1/2 pipe nipple, and bronze ball valve. Include metal enclosure labeled "MANUAL CONTROL STATION" with operating instructions and cover held closed by breakable strut to prevent accidental opening.

2.014 CONTROL PANELS

A. Description: Single-area, two-area, or single-area cross-zoned control panel as indicated, including NEMA ICS 6, Type 1 enclosure, detector, alarm, and solenoid-valve circuitry for operation of deluge valves. Panels contain power supply; battery charger; standby batteries; field-wiring terminal strip; electrically supervised solenoid valves and polarized fire-alarm bell; lamp test facility; single-pole, double-throw auxiliary alarm contacts; and rectifier.
    1. Panels: UL listed and FM approved when used with thermal detectors and Class A detector circuit wiring. Electrical characteristics are 120-V ac, 60 Hz, with 24-V dc rechargeable batteries.
    2. Manual Control Stations: Electric operation, metal enclosure, labeled "MANUAL CONTROL STATION" with operating instructions and cover held closed by breakable strut to prevent accidental opening.
    3. Manual Control Stations: Hydraulic operation, with union, NPS 1/2 pipe nipple, and bronze ball valve. Include metal enclosure labeled "MANUAL CONTROL STATION" with operating instructions and cover held closed by breakable strut to prevent accidental opening.

2.015 PRESSURE GAGES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following :
    1. AMETEK; U.S. Gauge Division.
    2. Ashcroft, Inc.
    3. Brecco Corporation.
    4. WIKA Instrument Corporation.
B. Standard: UL 393.
C. Dial Size: 3-1/2- to 4-1/2-inch diameter.
D. Pressure Gage Range: 0 to 250 psig minimum.
E. Water System Piping Gage: Include "WATER" or "AIR/WATER" label on dial face.
F. Air System Piping Gage: Include retard feature and "AIR" or "AIR/WATER" label on dial face.

2.016 ESCUTCHEONS

A. General: Manufactured ceiling, floor, and wall escutcheons and floor plates.
B. One-Piece, Cast-Brass Escutcheons: Polished chrome-plated finish with set-screws.
C. One-Piece, Deep-Pattern Escutcheons: Deep-drawn, box-shaped brass with chrome-plated finish.
D. One-Piece, Stamped-Steel Escutcheons: Chrome-plated finish with set-screw.

E. Split-Casting, Cast-Brass Escutcheons: Polished chrome-plated finish with concealed hinge and set-screw.

F. Split-Plate, Stamped-Steel Escutcheons: Chrome-plated finish with concealed hinge.

G. One-Piece Floor Plates: Cast-iron flange with holes for fasteners.

H. Split-Casting Floor Plates: Cast brass with concealed hinge.

2.017 SLEEVES

A. Cast-Iron Wall Pipe Sleeves: Cast or fabricated of cast iron and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.

B. Galvanized-Steel-Sheet Sleeves: 0.0239-inch (0.6-mm) minimum thickness; round tube closed with welded longitudinal joint.

C. Molded-PE Sleeves: Reusable, PE, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.

D. Molded-PVC Sleeves: Permanent, with nailing flange for attaching to wooden forms.

E. PVC-Pipe Sleeves: ASTM D 1785, Schedule 40.

F. Galvanized-Steel-Pipe Sleeves: ASTM A 53/A 53M, Type E, standard weight, zinc coated, plain ends.

G. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.

1. Underdeck Clamp: Clamping ring with set-screws.

2.018 SLEEVE SEALS

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

1. Advance Products & Systems, Inc.
2. Calpico, Inc.
3. Metraflex, Inc.
4. Pipeline Seal and Insulator, Inc.

B. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.

1. Sealing Elements: EPDM-rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
2. Pressure Plates: Carbon steel.
3. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements.

2.019 GROUT

A. Standard: ASTM C 1107, Grade B, posthardening and volume adjusting, dry, hydraulic-cement grout.

B. Characteristics: Nonshrink, and recommended for interior and exterior applications.

C. Design Mix: 5000-psi, 28-day compressive strength.

D. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.01 PREPARATION

A. Perform fire-hydrant flow test according to NFPA 13 and NFPA 291. Use results for system design calculations required in "Quality Assurance" Article.

B. Report test results promptly and in writing.

3.02 SERVICE-ENTRANCE PIPING

A. Connect sprinkler piping to water-service piping for service entrance to building. Comply with requirements for exterior piping in Division 21 Section "Facility Fire-Suppression Water-Service Piping."

B. Install shutoff valve, as noted on drawings pressure gage, drain, and other accessories indicated at connection to water-service piping. Install shutoff valve, check valve, pressure gage, and drain at connection to water service.

3.03 WATER-SUPPLY CONNECTIONS

A. Connect sprinkler piping to building's interior water-distribution piping. Comply with requirements for interior piping in Division 22 Section "Domestic Water Piping."

B. Install shutoff valve, backflow preventer pressure gage, drain, and other accessories indicated at connection to water-distribution piping.

C. Install shutoff valve, check valve, pressure gage, and drain at connection to water supply.

3.04 PIPING INSTALLATION

A. Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Install piping as indicated, as far as practical.

1. Deviations from approved working plans for piping require written approval from authorities having jurisdiction. File written approval with Architect before deviating from approved working plans.

B. Piping Standard: Comply with requirements for installation of sprinkler piping in NFPA 13.

C. Install seismic restraints on piping. Comply with requirements for seismic-restraint device materials and installation in NFPA 13.

D. Use listed fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.

E. Install unions adjacent to each valve in pipes NPS 2 and smaller.

F. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.

G. Install "Inspector's Test Connections" in sprinkler system piping, complete with shutoff valve, and sized and located according to NFPA 13.

H. Install sprinkler piping with drains for complete system drainage.

I. Install sprinkler control valves, test assemblies, and drain risers adjacent to standpipes when sprinkler piping is connected to standpipes.

J. Install automatic ball drip drain valve at each check valve for fire-department connection, to drain piping between fire-department connection and check valve. Install drain piping to and spill over floor drain or to outside building.

K. Install alarm devices in piping systems.

L. Install hangers and supports for sprinkler system piping according to NFPA 13. Comply with requirements for hanger materials in NFPA 13.

M. Install pressure gages on riser or feed main, at each sprinkler test connection, and at top of each standpipe. Include pressure gages with connection not less than NPS 1/4 (DN 8) and with soft metal seated globe valve, arranged for draining pipe between gage and valve. Install gages to permit removal, and install where they will not be subject to freezing.

N. Pressurize and check preaction sprinkler system piping and air-pressure maintenance devices.

O. Fill sprinkler system piping with water.

P. Install electric heating cables and pipe insulation on sprinkler piping in areas subject to freezing. Comply with requirements for heating cables in Division 21 "Heat Tracing for Fire-Suppression Piping" and for piping insulation in Division 21 Section "Fire-Suppression Systems Insulation."

3.05 JOINT CONSTRUCTION

A. Install couplings, flanges, flanged fittings, unions, nipples, and transition and special fittings that have finish and pressure ratings same as or higher than system's pressure rating for aboveground applications unless otherwise indicated.

B. Install unions adjacent to each valve in pipes NPS 2 and smaller.

C. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.

D. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

E. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.

F. Flanged Joints: Select appropriate gasket material in size, type, and thickness suitable for water service. Join flanges with gasket and bolts according to ASME B31.9.

G. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.

H. Twist-Locked Joints: Insert plain end of steel pipe into plain-end-pipe fitting. Rotate retainer lugs one-quarter turn or tighten retainer pin.

I. Steel-Piping, Pressure-Sealed Joints: Join lightwall steel pipe and steel pressure-seal fittings with tools recommended by fitting manufacturer.

J. Welded Joints: Construct joints according to AWS D10.12M/D10.12, using qualified processes and welding operators according to "Quality Assurance" Article.

1. Shop weld pipe joints where welded piping is indicated. Do not use welded joints for galvanized-steel pipe.

K. Steel-Piping, Cut-Grooved Joints: Cut square-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe joints.

L. Steel-Piping, Roll-Grooved Joints: Roll rounded-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe grooved joints.

M. Steel-Piping, Pressure-Sealed Joints: Join Schedule 5 steel pipe and steel pressure-seal fittings with tools recommended by fitting manufacturer.

N. Brazed Joints: Join copper tube and fittings according to CDA's "Copper Tube Handbook," "Brazed Joints" Chapter.

O. Copper-Tubing Grooved Joints: Roll rounded-edge groove in end of tube according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join copper tube and grooved-end fittings according to AWWA C606 for steel-pipe grooved joints.

P. Copper-Tubing, Pressure-Sealed Joints: Join copper tube and copper pressure-seal fittings with tools recommended by fitting manufacturer.

Q. Extruded-Tee Connections: Form tee in copper tube according to ASTM F 2014. Use tool designed for copper tube; drill pilot hole, form collar for outlet, dimple tube to form seating stop, and braze branch tube into collar.

R. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.

S. Plastic-Piping, Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:

1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements. Apply primer.
2. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.

3.06 INSTALLATION OF COVER SYSTEM FOR SPRINKLER PIPING

A. Install cover system, brackets, and cover components for sprinkler piping according to manufacturer's "Installation Manual" and with NFPA 13 or NFPA 13R for supports.

3.07 VALVE AND SPECIALTIES INSTALLATION

A. Install listed fire-protection valves, trim and drain valves, specialty valves and trim, controls, and specialties according to NFPA 13 and authorities having jurisdiction.

B. Install listed fire-protection shutoff valves supervised open, located to control sources of water supply except from fire-department connections. Install permanent identification signs indicating portion of system controlled by each valve.

C. Install check valve in each water-supply connection. Install backflow preventers instead of check valves in potable-water-supply sources.

D. Specialty Valves:

1. General Requirements: Install in vertical position for proper direction of flow, in main supply to system.
2. Alarm Valves: Include bypass check valve and retarding chamber drain-line connection.
3. Deluge Valves: Install in vertical position, in proper direction of flow, and in main supply to deluge system. Install trim sets for drain, priming level, alarm connections, ball drip valves, pressure gages, priming chamber attachment, and fill-line attachment.

3.08 SPRINKLER INSTALLATION

A. Install sprinklers in suspended ceilings in center of narrow dimension of acoustical ceiling panels.

B. Install dry-type sprinklers with water supply from heated space. Do not install pendent or sidewall, wet-type sprinklers in areas subject to freezing.

C. Install sprinklers into flexible, sprinkler hose fittings and install hose into bracket on ceiling grid.

3.09 FIRE-DEPARTMENT CONNECTION INSTALLATION

A. Install wall-type, fire-department connections.

B. Install yard-type, fire-department connections in concrete slab support. Comply with requirements for concrete in Division 03 Section "Cast-in-Place Concrete.".

1. Install two protective pipe bollards on sides of each fire-department connection. Comply with requirements for bollards in Division 05 Section "Metal Fabrications".

C. Install automatic drain valve at each check valve for fire-department connection.

3.010 ESCUTCHEON INSTALLATION

A. Install escutcheons for penetrations of walls, ceilings, and floors.

B. Escutcheons for New Piping:

1. Piping with Fitting or Sleeve Protruding from Wall: One piece, deep pattern.
2. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One piece, cast brass with polished chrome-plated finish.
3. Bare Piping at Ceiling Penetrations in Finished Spaces: One piece, cast brass with polished chrome-plated finish.
4. Bare Piping in Unfinished Service Spaces: One piece, cast brass with polished chrome-plated finish.
5. Bare Piping in Equipment Rooms: One piece, cast brass.
6. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece floor plate.

C. Escutcheons for Existing Piping:

1. Chrome-Plated Piping: Split casting, cast brass with chrome-plated finish.
2. Insulated Piping: Split plate, stamped steel with concealed hinge and spring clips.
3. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split casting, cast brass with chrome-plated finish.
4. Bare Piping at Ceiling Penetrations in Finished Spaces: Split casting, cast brass with chrome-plated finish.
5. Bare Piping in Unfinished Service Spaces: Split casting, cast brass with polished chrome-plated finish.
6. Bare Piping in Equipment Rooms: Split casting, cast brass.
7. Bare Piping at Floor Penetrations in Equipment Rooms: Split-casting floor plate.

3.011 SLEEVE INSTALLATION

A. General Requirements: Install sleeves for pipes and tubes passing through penetrations in floors, partitions, roofs, and walls.

B. Sleeves are not required for core-drilled holes.

C. Permanent sleeves are not required for holes formed by removable PE sleeves.

D. Cut sleeves to length for mounting flush with both surfaces unless otherwise indicated.

E. Install sleeves in new partitions, slabs, and walls as they are built.

F. For interior wall penetrations, seal annular space between sleeve and pipe or pipe insulation using joint sealants appropriate for size, depth, and location of joint. Comply with requirements for joint sealants in Division 07 Section "Joint Sealants."

G. For exterior wall penetrations above grade, seal annular space between sleeve and pipe using joint sealants appropriate for size, depth, and location of joint. Comply with requirements for joint sealants in Division 07 Section "Joint Sealants."

H. For exterior wall penetrations below grade, seal annular space between sleeve and pipe using sleeve seals.

I. Seal space outside of sleeves in concrete slabs and walls with grout.

J. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation unless otherwise indicated.

K. Install sleeve materials according to the following applications:

1. Sleeves for Piping Passing through Concrete Floor Slabs: Molded PE.
2. Sleeves for Piping Passing through Concrete Floor Slabs of Mechanical Equipment Areas or Other Wet Areas: Galvanized-steel pipe.
    a. Extend sleeves 2 inches above finished floor level.
    b. For pipes penetrating floors with membrane waterproofing, extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level. Comply with requirements for flashing in Division 07 Section "Sheet Metal Flashing and Trim."
3. Sleeves for Piping Passing through Gypsum-Board Partitions:
    a. PVC-pipe sleeves for pipes smaller than NPS 6.
    b. Galvanized-steel-sheet sleeves for pipes NPS 6 and larger.
    c. Exception: Sleeves are not required for water-supply tubes and waste pipes for individual plumbing fixtures if escutcheons will cover openings.
4. Sleeves for Piping Passing through Concrete Roof Slabs: Molded PE.
5. Sleeves for Piping Passing through Exterior Concrete Walls:

a. Galvanized-steel-pipe sleeves for pipes smaller than NPS 6.

b. Cast-iron wall-pipe sleeves for pipes NPS 6 and larger.

c. Install sleeves that are large enough to provide 1-inch annular clear space between sleeve and pipe or pipe insulation when sleeve seals are used.

6. Sleeves for Piping Passing through Interior Concrete Walls:

a. PVC-pipe sleeves for pipes smaller than NPS 6.

b. Galvanized-steel-sheet sleeves for pipes NPS 6 and larger.

L. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements for firestop materials and installations in Division 07 Section "Penetration Firestopping."

3.012 SLEEVE SEAL INSTALLATION

A. Install sleeve seals in sleeves in exterior concrete walls at water-service piping entries into building.

B. Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble sleeve seal components and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.013 IDENTIFICATION

A. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 13.

B. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

3.014 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:

1. Leak Test: After installation, charge systems and test for leaks. Repair leaks and retest until no leaks exist.

2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3. Flush, test, and inspect sprinkler systems according to NFPA 13, "Systems Acceptance" Chapter.

4. Energize circuits to electrical equipment and devices.

5. Start and run excess-pressure pumps.

6. Coordinate with fire-alarm tests. Operate as required.

7. Coordinate with fire-pump tests. Operate as required.

8. Verify that equipment hose threads are same as local fire-department equipment.

C. Sprinkler piping system will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

3.015 CLEANING

A. Clean dirt and debris from sprinklers.

B. Remove and replace sprinklers with paint other than factory finish.

3.016 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain specialty valves.

3.017 PIPING SCHEDULE

A. Piping between Fire-Department Connections and Check Valves: Galvanized, standard-weight steel pipe with threaded ends; cast-iron threaded fittings; and threaded.

B. Sprinkler specialty fittings may be used, downstream of control vales, instead of specified fittings.

C. Copper-tube, extruded-tee connections may be used for tee branches in copper tubing instead of specified copper fittings. Branch-connection joints must be brazed.

D. Standard-pressure, wet-pipe sprinkler system, NPS 2 and smaller shall be the following:

1. Standard-weight Schedule 40, black-steel pipe with threaded ends; uncoated, gray-iron threaded fittings; and threaded joints.
2. Standard-weight Schedule 40, galvanized-steel pipe with threaded ends; galvanized, gray-iron threaded fittings; and threaded joints.
3. Standard-weight Schedule 40, black-steel pipe with plain ends; uncoated, plain-end-pipe fittings; and twist-locked joints.
4. Standard-weight Schedule 40 galvanized-steel pipe with plain ends; galvanized, plain-end-pipe fittings; and twist-locked joints.
5. Standard-weight Schedule 40, black-steel pipe with cut or roll grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
6. Standard-weight Schedule 40, galvanized-steel pipe with cut-grooved ends; galvanized, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
7. Standard-weight Schedule 40, black-steel pipe with plain ends; steel welding fittings; and welded joints.
8. Schedule 10 black-steel pipe with roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
9. Schedule 10 black-steel pipe with plain ends; ncoated, plain-end-pipe fittings; and twist-locked joints.
10. Schedule 10 black-steel pipe with plain ends; welding fittings; and welded joints.
11. Schedule 5 steel pipe; steel pressure-seal fittings; and pressure-sealed joints.
12. Type L Type B, hard copper tube with plain ends; cast-copper solder-joint fittings; and brazed joints.
13. Type L hard copper tube with plain ends; copper pressure-seal fittings; and pressure-sealed joints.
14. NPS 2, Type L Type M, hard copper tube with roll-grooved ends; copper, grooved-end fittings; grooved-end-tube couplings; and grooved joints.

E. Standard-pressure, wet-pipe sprinkler system, NPS 2-1/2 to NPS 4 the following:

1. Standard-weight, black-steel pipe with threaded ends; uncoated, gray-iron threaded fittings; and threaded joints.
2. Standard-weight, galvanized-steel pipe with threaded ends; galvanized, gray-iron threaded fittings; and threaded joints.
3. Standard-weight, black-steel pipe with cut-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
4. Standard-weight galvanized-steel pipe with cut-grooved ends; galvanized, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
5. Standard-weight, black-steel pipe with plain ends; steel welding fittings; and welded joints.

6. Schedule 10 black-steel pipe with roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
7. Schedule 10 black-steel pipe with plain ends; welding fittings; and welded joints.
8. Type L Type B, hard copper tube with plain ends; cast-copper solder-joint fittings; and brazed joints.
9. Type L Type B hard copper tube with plain ends; copper pressure-seal fittings; and pressure-sealed joints.
10. Type L, hard copper tube with roll-grooved ends; copper, grooved-end fittings; grooved-end-tube couplings; and grooved joints.

F. Standard-pressure, wet-pipe sprinkler system, NPS 5 and larger, shall be one of the following:
1. Standard-weight, black-steel pipe with threaded ends; uncoated, gray-iron threaded fittings; and threaded joints.
2. Standard-weight, galvanized-steel pipe with threaded ends; galvanized, gray-ron threaded fittings; and threaded joints.
3. Standard-weight, black-steel pipe with roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
4. Standard-weight, galvanized-steel pipe with cut-grooved ends; galvanized, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
5. Standard-weight, black-steel pipe with plain ends; steel welding fittings; and welded joints.
6. Type L hard copper tube with plain ends; cast-copper solder-joint fittings; and brazed joints.
7. Type L, hard copper tube with roll-grooved ends; copper, grooved-end fittings; grooved-end-tube couplings; and grooved joints.

3.018 SPRINKLER SCHEDULE

A. Use sprinkler types in subparagraphs below for the following applications:
1. Rooms without Ceilings: Upright sprinklers.
2. Rooms with Suspended Ceilings: Concealed sprinklers
3. Wall Mounting: Sidewall sprinklers.
4. Spaces Subject to Freezing: Upright sprinklers

B. Provide sprinkler types in subparagraphs below with finishes indicated.
1. Concealed Sprinklers: Rough brass, with factory-painted white cover plate.
2. Flush Sprinklers: Bright chrome, with painted white escutcheon.
3. Recessed Sprinklers: Bright chrome, with bright chrome escutcheon.
4. Upright and Sidewall Sprinklers: Chrome plated in finished spaces exposed to view; rough bronze in unfinished spaces not exposed to view; wax coated where exposed to acids, chemicals, or other corrosive fumes.

END OF SECTION 21 1313

SECTION 22 0500

COMMON WORK RESULTS FOR PLUMBING

PART 1 - GENERAL

1.01 SUMMARY

A. This Section includes the following:

1. Piping materials and installation instructions common to most piping systems.
2. Dielectric fittings.
3. Mechanical sleeve seals.
4. Sleeves.
5. Escutcheons.
6. Grout.
7. Equipment installation requirements common to equipment sections.
8. Concrete bases.
9. Supports and anchorages.

1.02 DEFINITIONS

A. Finished Spaces: Spaces other than plumbing and electrical equipment rooms, furred spaces, pipe chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.

B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and plumbing equipment rooms.

C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in chases.

E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

1.03 SUBMITTALS

A. Welding certificates.

1.04 QUALITY ASSURANCE

A. Comply with 2012 UPC, and 2010 NFPA 24 and 2012 NFPA 1.

B. Comply 2010 NFPA 24 and NFPA 1.

C. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."

D. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."

1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

E. Electrical Characteristics for Plumbing Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

PART 2 - PRODUCTS

2.01 PIPE, TUBE, AND FITTINGS

A. Refer to individual Division 22 piping Sections for pipe, tube, and fitting materials and joining methods.

B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.02 JOINING MATERIALS

A. Refer to individual Division 22 piping Sections for special joining materials not listed below.

B. Pipe-Flange Gasket Materials: ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch (3.2-mm) maximum thickness unless thickness or specific material is indicated.

C. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.

D. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

E. Brazing Filler Metals: AWS A5.8, BCuP Series or BAg1, unless otherwise indicated.

F. Welding Filler Metals: Comply with AWS D10.12.

G. Solvent Cements for Joining Plastic Piping:

1. ABS Piping: ASTM D 2235.
2. CPVC Piping: ASTM F 493.
3. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.
4. PVC to ABS Piping Transition: ASTM D 3138.

2.03 DIELECTRIC FITTINGS

A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.

B. Insulating Material: Suitable for system fluid, pressure, and temperature.

C. Dielectric Unions: Factory-fabricated, union assembly, for 250-psig minimum working pressure at 180 deg F.

D. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150-psig minimum working pressure as required to suit system pressures.

E. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psig minimum working pressure at 225 deg F.

F. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig minimum working pressure at 225 deg F.

2.04 MECHANICAL SLEEVE SEALS

A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.

B. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.

C. Pressure Plates: Plastic. Include two for each sealing element.

D. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.05 SLEEVES

A. Galvanized-Steel Sheet: 0.0239-inch (0.6-mm) minimum thickness; round tube closed with welded longitudinal joint.

B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.

C. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

D. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.

1. Underdeck Clamp: Clamping ring with set screws.

E. Molded PVC: Permanent, with nailing flange for attaching to wooden forms.

F. PVC Pipe: ASTM D 1785, Schedule 40.

G. Molded PE: Reusable, PE, tapered-cup shaped, and smooth-outer surface with nailing flange for attaching to wooden forms.

2.06 ESCUTCHEONS

A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.

B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished chrome-plated finish.

C. One-Piece, Cast-Brass Type: With set screw.

1. Finish: Polished chrome-plated.

D. Split-Casting, Cast-Brass Type: With concealed hinge and set screw.

1. Finish: Polished chrome-plated.

2.07 GROUT

A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.

1. Characteristics: Post-hardening, volume-adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
2. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.
3. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.01 PIPING SYSTEMS - COMMON REQUIREMENTS

A. Install piping according to the following requirements and Division 22 Sections specifying piping systems.

B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.

D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

F. Install piping to permit valve servicing.

G. Install piping at indicated slopes.

H. Install piping free of sags and bends.

I. Install fittings for changes in direction and branch connections.

J. Install piping to allow application of insulation.

K. Select system components with pressure rating equal to or greater than system operating pressure.

L. Install escutcheons for penetrations of walls, ceilings, and floors.

M. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.

N. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.

1. Install steel pipe for sleeves smaller than 6 inches (150 mm) in diameter.
2. Install cast-iron "wall pipes" for sleeves 6 inches (150 mm) and larger in diameter.
3. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

O. Underground, Exterior-Wall Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.

1. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

P. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 07 Section "Penetration Firestopping" for materials.

Q. Verify final equipment locations for roughing-in.

R. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.02 PIPING JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements and Division 22 Sections specifying piping systems.

B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.

E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.

F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

G. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.

H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

I. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:

1. Comply with ASTM F 402, for safe-handling practice of cleaners, primers, and solvent cements.
2. ABS Piping: Join according to ASTM D 2235 and ASTM D 2661 Appendixes.
3. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
4. PVC Pressure Piping: Join schedule number ASTM D 1785, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule-number PVC pipe and socket fittings according to ASTM D 2855.
5. PVC Nonpressure Piping: Join according to ASTM D 2855.
6. PVC to ABS Nonpressure Transition Fittings: Join according to ASTM D 3138 Appendix.

J. Plastic Pressure Piping Gasketed Joints: Join according to ASTM D 3139.

K. Plastic Nonpressure Piping Gasketed Joints: Join according to ASTM D 3212.

3.03 PIPING CONNECTIONS

A. Make connections according to the following, unless otherwise indicated:

1. Install unions, in piping NPS 2 (DN 50) and smaller, adjacent to each valve and at final connection to each piece of equipment.
2. Install flanges, in piping NPS 2-1/2 (DN 65) and larger, adjacent to flanged valves and at final connection to each piece of equipment.
3. Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of dissimilar metals.
4. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

3.04 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.

B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.

C. Install plumbing equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.

D. Install equipment to allow right of way for piping installed at required slope.

3.05 CONCRETE BASES

A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions and according to seismic codes at Project.

1. Construct concrete bases of dimensions indicated, but not less than 4 inches (100 mm) larger in both directions than supported unit.
2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around the full perimeter of the base.
3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

5. Install anchor bolts to elevations required for proper attachment to supported equipment.
6. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
7. Use 3000-psi (20.7-MPa), 28-day compressive-strength concrete and reinforcement as specified in Division 03 Section "Cast-in-Place Concrete."

3.06 ERECTION OF METAL SUPPORTS AND ANCHORAGES

A. Refer to Division 05 Section "Metal Fabrications" for structural steel.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor plumbing materials and equipment.

C. Field Welding: Comply with AWS D1.1.

3.07 GROUTING

A. Mix and install grout for plumbing equipment base bearing surfaces, pump and other equipment base plates, and anchors.

B. Clean surfaces that will come into contact with grout.

C. Provide forms as required for placement of grout.

D. Avoid air entrapment during placement of grout.

E. Place grout, completely filling equipment bases.

F. Place grout on concrete bases and provide smooth bearing surface for equipment.

G. Place grout around anchors.

H. Cure placed grout.

END OF SECTION 22 0500

SECTION 22 0529

HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

All suspended piping and equipment shall be supported from the structure. Hangers and supports shall not be suspended from roof deck.

1.01 SUMMARY

A. Section Includes:

1. Metal pipe hangers and supports.
2. Trapeze pipe hangers.
3. Thermal-hanger shield inserts.
4. Fastener systems.
5. Pipe positioning systems.
6. Equipment supports.

1.02 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design trapeze pipe hangers and equipment supports, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. Structural Performance: Hangers and supports for plumbing piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.

1. Design supports for multiple pipes capable of supporting combined weight of supported systems, system contents, and test water.
2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
3. Design seismic-restraint hangers and supports for piping and equipment and obtain approval from authorities having jurisdiction.

1.03 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: Signed and sealed by a qualified professional engineer. Show fabrication and installation details and include calculations for the following; include Product Data for components:

1. Trapeze pipe hangers.
2. Equipment supports.

C. Delegated-Design Submittal: For trapeze hangers indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

D. Welding certificates.

1.04 QUALITY ASSURANCE

A. Structural Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

PART 2 - PRODUCTS

2.01 METAL PIPE HANGERS AND SUPPORTS

A. Carbon-Steel Pipe Hangers and Supports:

1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
2. Galvanized Metallic Coatings: Pregalvanized or hot dipped.
3. Nonmetallic Coatings: Plastic coating, jacket, or liner.
4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
5. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.

B. Copper Pipe Hangers:

1. Description: MSS SP-58, Types 1 through 58, copper-coated-steel, factory-fabricated components.
2. Hanger Rods: Continuous-thread rod, nuts, and washer made of copper-coated steel.

2.02 TRAPEZE PIPE HANGERS

A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural carbon-steel shapes with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts.

2.03 THERMAL-HANGER SHIELD INSERTS

A. Insulation-Insert Material for Cold Piping: ASTM C 552, Type II cellular glass with 100-psig (688-kPa) or ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig (862-kPa) minimum compressive strength and vapor barrier.

B. Insulation-Insert Material for Hot Piping: ASTM C 552, Type II cellular glass with 100-psig (688-kPa) minimum compressive strength.

C. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.

D. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.

E. Insert Length: Extend 2 inches (50 mm) beyond sheet metal shield for piping operating below ambient air temperature.

2.04 FASTENER SYSTEMS

A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

B. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel anchors, for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

2.05 PIPE POSITIONING SYSTEMS

A. Description: IAPMO PS 42, positioning system of metal brackets, clips, and straps for positioning piping in pipe spaces; for plumbing fixtures in commercial applications.

2.06 EQUIPMENT SUPPORTS

A. Description: Welded, shop- or field-fabricated equipment support made from structural carbon-steel shapes.

2.07 MISCELLANEOUS MATERIALS

A. Structural Steel: ASTM A 36/A 36M, carbon-steel plates, shapes, and bars; black and galvanized.

B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.

1. Properties: Nonstaining, noncorrosive, and nongaseous.
2. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.

PART 3 - EXECUTION

3.01 HANGER AND SUPPORT INSTALLATION

A. Metal Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.

B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.

1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified for individual pipe hangers.

2. Field fabricate from ASTM A 36/A 36M, carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.

C. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.

D. Fastener System Installation:

1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches (100 mm) thick in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.

2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.

E. Pipe Positioning-System Installation: Install support devices to make rigid supply and waste piping connections to each plumbing fixture. See Division 22 plumbing fixture Sections for requirements for pipe positioning systems for plumbing fixtures.

F. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.

G. Equipment Support Installation: Fabricate from welded-structural-steel shapes.

H. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

I. Install lateral bracing with pipe hangers and supports to prevent swaying.

J. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 (DN 65) and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.

K. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

L. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.

M. Insulated Piping:

1. Attach clamps and spacers to piping.

a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.

b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.

c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.

2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
    a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 (DN 100) and larger if pipe is installed on rollers.
3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
    a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 (DN 100) and larger if pipe is installed on rollers.
4. Shield Dimensions for Pipe: Not less than the following:
    a. NPS 1/4 to NPS 3-1/2 (DN 8 to DN 90): 12 inches (305 mm) long and 0.048 inch (1.22 mm) thick.
    b. NPS 4 (DN 100): 12 inches (305 mm) long and 0.06 inch (1.52 mm) thick.
    c. NPS 5 and NPS 6 (DN 125 and DN 150): 18 inches (457 mm) long and 0.06 inch (1.52 mm) thick.
    d. NPS 8 to NPS 14 (DN 200 to DN 350): 24 inches (610 mm) long and 0.075 inch (1.91 mm) thick.
    e. NPS 16 to NPS 24 (DN 400 to DN 600): 24 inches (610 mm) long and 0.105 inch (2.67 mm) thick.
5. Pipes NPS 8 (DN 200) and Larger: Include wood or reinforced calcium-silicate-insulation inserts of length at least as long as protective shield.
6. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.02 EQUIPMENT SUPPORTS

A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.

B. Grouting: Place grout under supports for equipment and make bearing surface smooth.

C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.03 METAL FABRICATIONS

A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.

B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.

C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:
1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. Finish welds at exposed connections so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

3.04 ADJUSTING

A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches (40 mm)

3.05 PAINTING

A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.

1. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils (0.05 mm).

B. Touchup: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Division 09 painting Sections.

C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

3.06 HANGER AND SUPPORT SCHEDULE

A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.

B. Comply with MSS SP-69 for pipe-hanger selections and applications that are not specified in piping system Sections.

C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.

D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.

E. Use carbon-steel pipe hangers and supports and metal trapeze pipe hangers and attachments for general service applications.

F. Use copper-plated pipe hangers and copper or stainless-steel attachments for copper piping and tubing.

G. Use padded hangers for piping that is subject to scratching.

H. Use thermal-hanger shield inserts for insulated piping and tubing.

I. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes NPS 1/2 to NPS 30 (DN 15 to DN 750).
2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of up to 1050 deg F (566 deg C), pipes NPS 4 to NPS 24 (DN 100 to DN 600), requiring up to 4 inches (100 mm) of insulation.
3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes NPS 3/4 to NPS 36 (DN 20 to DN 900), requiring clamp flexibility and up to 4 inches (100 mm) of insulation.
4. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8 (DN 15 to DN 200).
5. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30 (DN 15 to DN 750).
6. Pipe Saddle Supports (MSS Type 36): For support of pipes NPS 4 to NPS 36 (DN 100 to DN 900), with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate.
7. Pipe Stanchion Saddles (MSS Type 37): For support of pipes NPS 4 to NPS 36 (DN 100 to DN 900), with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.
8. Single-Pipe Rolls (MSS Type 41): For suspension of pipes NPS 1 to NPS 30 (DN 25 to DN 750), from two rods if longitudinal movement caused by expansion and contraction might occur.

9. Complete Pipe Rolls (MSS Type 44): For support of pipes NPS 2 to NPS 42 (DN 50 to DN 1050) if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.

J. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24 (DN 24 to DN 600).
2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 (DN 20 to DN 600) if longer ends are required for riser clamps.

K. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches (150 mm) for heavy loads.
2. Steel Clevises (MSS Type 14): For 120 to 450 deg F (49 to 232 deg C) piping installations.

L. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction, to attach to top flange of structural shape.
3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
6. C-Clamps (MSS Type 23): For structural shapes.
7. Welded-Steel Brackets: For support of pipes from below, or for suspending from above by using clip and rod. Use one of the following for indicated loads:
   a. Light (MSS Type 31): 750 lb (340 kg).
   b. Medium (MSS Type 32): 1500 lb (680 kg).
   c. Heavy (MSS Type 33): 3000 lb (1360 kg).
8. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
9. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.

M. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.

N. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches (32 mm).
2. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41, roll hanger with springs.

3. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from base support.

O. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.

P. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.

Q. Use pipe positioning systems in pipe spaces behind plumbing fixtures to support supply and waste piping for plumbing fixtures.

END OF SECTION 22 0529

SECTION 22 0700

PLUMBING INSULATION

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Insulation Materials:
    a. Cellular glass.
    b. Flexible elastomeric.
    c. Mineral fiber.
    d. Polyolefin.
    e. Polystyrene.
2. Insulating cements.
3. Adhesives.
4. Mastics.
5. Sealants.
6. Factory-applied jackets.
7. Field-applied fabric-reinforcing mesh.
8. Field-applied jackets.
9. Tapes.
10. Securements.
11. Corner angles.

B. Related Sections include the following:

1. Division 23 Section "HVAC Insulation."

1.02 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings:

1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
2. Detail attachment and covering of heat tracing inside insulation.
3. Detail insulation application at pipe expansion joints for each type of insulation.
4. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
5. Detail removable insulation at piping specialties, equipment connections, and access panels.
6. Detail application of field-applied jackets.
7. Detail application at linkages of control devices.
8. Detail field application for each equipment type.

C. Field quality-control reports.

1.03 QUALITY ASSURANCE

A. Fire-Test-Response Characteristics: Insulation and related materials shall have fire-test-response characteristics indicated, as determined by testing identical products per ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing and inspecting agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.

2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

PART 2 - PRODUCTS

2.01 INSULATION MATERIALS

A. Comply with requirements in Part 3 schedule articles for where insulating materials shall be applied.

B. Products shall not contain asbestos, lead, mercury, or mercury compounds.

C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.

D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.

E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

F. Cellular Glass: Inorganic, incombustible, foamed or cellulated glass with annealed, rigid, hermetically sealed cells. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   a. Cell-U-Foam Corporation; Ultra-CUF.
   b. Pittsburgh Corning Corporation; Foamglas Super K.
   c. Industrial Insulation Group
2. Block Insulation: ASTM C 552, Type I.
3. Special-Shaped Insulation: ASTM C 552, Type III.
4. Board Insulation: ASTM C 552, Type IV.
5. Preformed Pipe Insulation without Jacket: Comply with ASTM C 552, Type II, Class 1.
6. Preformed Pipe Insulation with Factory-Applied ASJ: Comply with ASTM C 552, Type II, Class 2.
7. Factory fabricate shapes according to ASTM C 450 and ASTM C 585.

G. Flexible Elastomeric: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials and Type II for sheet materials.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   a. Aeroflex USA Inc.; Aerocel.
   b. Armacell LLC; AP Armaflex.
   c. RBX Corporation; Insul-Sheet 1800 and Insul-Tube 180.

H. Polyolefin: Unicellular, polyethylene thermal plastic insulation. Comply with ASTM C 534 or ASTM C 1427, Type I, Grade 1 for tubular materials and Type II, Grade 1 for sheet materials.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   a. Armacell LLC; Tubolit.
   b. Nomaco Inc.; IMCOLOCK, IMCOSHEET, NOMALOCK, and NOMAPLY.
   c. RBX Corporation; Therma-cell.

I. Polystyrene: Rigid, extruded cellular polystyrene intended for use as thermal insulation. Comply with ASTM C 578, Type IV or Type XIII, except thermal conductivity (k-value) shall not exceed 0.26 Btu x in./h x sq. ft. x deg F (0.038 W/m x K) after 180 days of aging. Fabricate shapes according to ASTM C 450 and ASTM C 585.

1. Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
   a. Dow Chemical Company (The); Styrofoam.
   b. Knauf Insulation; Knauf Polystyrene.
   c. Nomaco Inc.

2.02 INSULATING CEMENTS

A. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449/C 449M.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    a. Insulco, Division of MFS, Inc.; SmoothKote.
    b. P. K. Insulation Mfg. Co., Inc.; PK No. 127, and Quik-Cote.
    c. Rock Wool Manufacturing Company; Delta One Shot.

2.03 ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.

B. Cellular-Glass Polystyrene Adhesive: Solvent-based resin adhesive, with a service temperature range of minus 75 to plus 300 deg F (minus 59 to plus 149 deg C).

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    a. Childers Products, Division of ITW; CP-96.
    b. Foster Products Corporation, H. B. Fuller Company; 81-33.
    c. Marathon Industries, Inc.; 290
2. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

C. Flexible Elastomeric and Polyolefin Adhesive: Comply with MIL-A-24179A, Type II, Class I.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    a. Aeroflex USA Inc.; Aeroseal.
    b. Armacell LCC; 520 Adhesive.
    c. Foster Products Corporation, H. B. Fuller Company; 85-75.
    d. RBX Corporation; Rubatex Contact Adhesive.
2. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

D. Polystyrene Adhesive: Solvent- or water-based, synthetic resin adhesive with a service temperature range of minus 20 to plus 140 deg F (29 to plus 60 deg C).

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    a. Childers Products, Division of ITW; CP-96.
    b. Foster Products Corporation, H. B. Fuller Company; 97-13.
    c. Nomaco Inc.; IMCOLOCK. IMCOSHEET, NOMALOCK, and NOMAPLY

E. ASJ Adhesive, and FSK and PVDC Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.

1. Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
    a. Childers Products, Division of ITW; CP-82.
    b. Foster Products Corporation, H. B. Fuller Company; 85-20.
    c. ITW TACC, Division of Illinois Tool Works; S-90/80.
    d. Marathon Industries, Inc.; 225.
    e. Mon-Eco Industries, Inc.; 22-25.
2. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

F. PVC Jacket Adhesive: Compatible with PVC jacket.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    a. Dow Chemical Company (The); 739, Dow Silicone.
    b. Johns-Manville; Zeston Perma-Weld, CEEL-TITE Solvent Welding Adhesive.
    c. P.I.C. Plastics, Inc.; Welding Adhesive.
    d. Speedline Corporation; Speedline Vinyl Adhesive.
2. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.04 MASTICS

A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-C-19565C, Type II.
1. For indoor applications, use mastics that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. Vapor-Barrier Mastic: Water based; suitable for indoor and outdoor use on below ambient services.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    a. Childers Products, Division of ITW; CP-35.
    b. Foster Products Corporation, H. B. Fuller Company; 30-90.
    c. ITW TACC, Division of Illinois Tool Works; CB-50.
    d. Marathon Industries, Inc.; 590.
    e. Mon-Eco Industries, Inc.; 55-40.
    f. Vimasco Corporation; 749.
2. Water-Vapor Permeance: ASTM E 96, Procedure B, 0.013 perm (0.009 metric perm) at 43-mil (1.09-mm) dry film thickness.
3. Service Temperature Range: Minus 20 to plus 180 deg F (Minus 29 to plus 82 deg C).
4. Solids Content: ASTM D 1644, 59 percent by volume and 71 percent by weight.
5. Color: White.

C. Breather Mastic: Water based; suitable for indoor and outdoor use on above ambient services.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    a. Childers Products, Division of ITW; CP-10.
    b. Foster Products Corporation, H. B. Fuller Company; 35-00.
    c. ITW TACC, Division of Illinois Tool Works; CB-05/15.
    d. Marathon Industries, Inc.; 550.
    e. Mon-Eco Industries, Inc.; 55-50.
    f. Vimasco Corporation; WC-1/WC-5.
2. Water-Vapor Permeance: ASTM F 1249, 3 perms (2 metric perms) at 0.0625-inch (1.6-mm) dry film thickness.
3. Service Temperature Range: Minus 20 to plus 200 deg F (Minus 29 to plus 93 deg C).
4. Solids Content: 63 percent by volume and 73 percent by weight.
5. Color: White.

2.05 SEALANTS

A. Joint Sealants:
1. Joint Sealants for Cellular-Glass Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    a. Childers Products, Division of ITW; CP-76.

b. Foster Products Corporation, H. B. Fuller Company; 30-45.

c. Marathon Industries, Inc.; 405.

d. Mon-Eco Industries, Inc.; 44-05.

e. Pittsburgh Corning Corporation; Pittseal 444.

f. Vimasco Corporation; 750.

2. Joint Sealants for Polystyrene Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Childers Products, Division of ITW; CP-70.

b. Foster Products Corporation, H. B. Fuller Company; 30-45/30-46.

c. Marathon Industries, Inc.; 405.

d. Mon-Eco Industries, Inc.; 44-05.

e. Vimasco Corporation; 750.

3. Materials shall be compatible with insulation materials, jackets, and substrates.

4. Permanently flexible, elastomeric sealant.

5. Service Temperature Range: Minus 100 to plus 300 deg F (Minus 73 to plus 149 deg C).

6. Color: White or gray.

7. For indoor applications, use sealants that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. FSK and Metal Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Childers Products, Division of ITW; CP-76-8.

b. Foster Products Corporation, H. B. Fuller Company; 95-44.

c. Marathon Industries, Inc.; 405.

d. Mon-Eco Industries, Inc.; 44-05.

e. Vimasco Corporation; 750.

2. Materials shall be compatible with insulation materials, jackets, and substrates.

3. Fire- and water-resistant, flexible, elastomeric sealant.

4. Service Temperature Range: Minus 40 to plus 250 deg F (Minus 40 to plus 121 deg C).

5. Color: Aluminum.

6. For indoor applications, use sealants that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

C. ASJ Flashing Sealants, and Vinyl, PVDC, and PVC Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Childers Products, Division of ITW; CP-76.

b. Foster Products Corporation, H. B. Fuller Company; 95-44.

c. Marathon Industries, Inc.; 405.

2. Materials shall be compatible with insulation materials, jackets, and substrates.

3. Fire- and water-resistant, flexible, elastomeric sealant.

4. Service Temperature Range: Minus 40 to plus 250 deg F (Minus 40 to plus 121 deg C).

5. Color: White.

6. For indoor applications, use sealants that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.06 FACTORY-APPLIED JACKETS

A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:

1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.
3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.
4. PVDC Jacket for Indoor Applications: 4-mil- (0.10-mm-) thick, white PVDC biaxially oriented barrier film with a permeance at 0.02 perms (0.013 metric perms) when tested according to ASTM E 96 and with a flame-spread index of 5 and a smoke-developed index of 20 when tested according to ASTM E 84.
    a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
        1) Dow Chemical Company (The); Saran 540 Vapor Retarder Film and Saran 560 Vapor Retarder Film.
        2) Vimasco Corporation; Elastafab 894.
        3) Childers Products, Division of ITW; Chil-Glas No. 5
5. PVDC Jacket for Outdoor Applications: 6-mil- (0.15-mm-) thick, white PVDC biaxially oriented barrier film with a permeance at 0.01 perms (0.007 metric perms) when tested according to ASTM E 96 and with a flame-spread index of 5 and a smoke-developed index of 25 when tested according to ASTM E 84.
    a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
        1) Dow Chemical Company (The); Saran 540 Vapor Retarder Film and Saran 560 Vapor Retarder Film.
        2) Vimasco Corporation; Elastafab 894.
        3) Childers Products, Division of ITW; Chil-Glas No. 5
6. PVDC-SSL Jacket: PVDC jacket with a self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip.
    a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
        1) Dow Chemical Company (The); Saran 540 Vapor Retarder Film and Saran 560 Vapor Retarder Film.
        2) Vimasco Corporation; Elastafab 894.
        3) Childers Products, Division of ITW; Chil-Glas No. 5

2.07 FIELD-APPLIED FABRIC-REINFORCING MESH

A. Woven Polyester Fabric: Approximately 1 oz./sq. yd. (34 g/sq. m) with a thread count of 10 strands by 10 strands/sq. inch (4 strands by 4 strands/sq. mm), in a Leno weave, for equipment and pipe.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    a. Foster Products Corporation, H. B. Fuller Company; Mast-A-Fab.
    b. Vimasco Corporation;
    c. Elastafab 894. Mon-Eco Industries, Inc.; 44-05.

2.08 FIELD-APPLIED JACKETS

A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.

B. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    a. Johns Manville; Zeston.
    b. P.I.C. Plastics, Inc.; FG Series.
    c. Proto PVC Corporation; LoSmoke.
    d. Speedline Corporation; SmokeSafe.
2. Adhesive: As recommended by jacket material manufacturer.
3. Color: White.
4. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.
    a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.
5. Factory-fabricated tank heads and tank side panels.

C. Aluminum Jacket: Comply with ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105 or 5005, Temper H-14.

1. Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
    a. Childers Products, Division of ITW; Metal Jacketing Systems.
    b. PABCO Metals Corporation; Surefit.
    c. RPR Products, Inc.; Insul-Mate.
2. Factory cut and rolled to size.
3. Finish and thickness are indicated in field-applied jacket schedules.
4. Moisture Barrier for Indoor Applications: 3-mil- (0.075-mm-) thick, heat-bonded polyethylene and kraft paper.
5. Moisture Barrier for Outdoor Applications: 3-mil- (0.075-mm-) thick, heat-bonded polyethylene and kraft paper.
6. Factory-Fabricated Fitting Covers:
    a. Same material, finish, and thickness as jacket.
    b. Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
    c. Tee covers.
    d. Flange and union covers.
    e. End caps.
    f. Beveled collars.
    g. Valve covers.
    h. Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

D. Underground Direct-Buried Jacket: 125-mil- (3.2-mm-) thick vapor barrier and waterproofing membrane consisting of a rubberized bituminous resin reinforced with a woven-glass fiber or polyester scrim and laminated aluminum foil.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    a. Pittsburgh Corning Corporation; Pittwrap.
    b. Polyguard; Insulrap No Torch 125.
    c. Avery Dennison Corporation

2.09 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0835.
   b. Compac Corp.; 104 and 105.
   c. Ideal Tape Co., Inc., an American Biltrite Company; 428 AWF ASJ.
   d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.
2. Width: 3 inches (75 mm).
3. Thickness: 11.5 mils (0.29 mm).
4. Adhesion: 90 ounces force/inch (1.0 N/mm) in width.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch (7.2 N/mm) in width.
7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0827.
   b. Compac Corp.; 110 and 111.
   c. Ideal Tape Co., Inc., an American Biltrite Company; 491 AWF FSK.
   d. Venture Tape; 1525 CW, 1528 CW, and 1528 CW/SQ.
2. Width: 3 inches (75 mm).
3. Thickness: 6.5 mils (0.16 mm).
4. Adhesion: 90 ounces force/inch (1.0 N/mm) in width.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch (7.2 N/mm) in width.
7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

C. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive. Suitable for indoor and outdoor applications.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0555.
   b. Compac Corp.; 130.
   c. Ideal Tape Co., Inc., an American Biltrite Company; 370 White PVC tape.
   d. Venture Tape; 1506 CW NS.
2. Width: 2 inches (50 mm).
3. Thickness: 6 mils (0.15 mm).
4. Adhesion: 64 ounces force/inch (0.7 N/mm) in width.
5. Elongation: 500 percent.
6. Tensile Strength: 18 lbf/inch (3.3 N/mm) in width.

D. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0800.

b. Compac Corp.; 120.

c. Ideal Tape Co., Inc., an American Biltrite Company; 488 AWF.

d. Venture Tape; 3520 CW.

2. Width: 2 inches (50 mm).

3. Thickness: 3.7 mils (0.093 mm).

4. Adhesion: 100 ounces force/inch (1.1 N/mm) in width.

5. Elongation: 5 percent.

6. Tensile Strength: 34 lbf/inch (6.2 N/mm) in width.

E. PVDC Tape: White vapor-retarder PVDC tape with acrylic adhesive.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Dow Chemical Company (The); Saran 540 Vapor Retarder Tape.

b. Vimasco Corporation; Elastafab 894

c. Childers Products; Division of ITW; Chil-Glas No. 5

2. Width: 3 inches (75 mm).

3. Film Thickness: 6 mils (0.15 mm).

4. Adhesive Thickness: 1.5 mils (0.04 mm).

5. Elongation at Break: 145 percent.

6. Tensile Strength: 55 lbf/inch (10.1 N/mm) in width.

2.010 SECUREMENTS

A. Aluminum Bands: ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch (0.51 mm) thick, 3/4 inch (19 mm) wide wing or closed seal.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Childers Products; Bands.

b. PABCO Metals Corporation; Bands.

c. RPR Products, Inc.; Bands.

B. Insulation Pins and Hangers:

1. Metal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:

a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

1) AGM Industries, Inc.; Tactoo Insul-Hangers, Series T.

2) GEMCO; Perforated Base.

3) Midwest Fasteners, Inc.; Spindle.

b. Baseplate: Perforated, galvanized carbon-steel sheet, 0.030 inch (0.76 mm) thick by 2 inches (50 mm) square.

c. Spindle: Copper- or zinc-coated, low carbon stee], fully annealed, 0.106-inch- (2.6-mm-) diameter shank, length to suit depth of insulation indicated.

d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.

2. Nonmetal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate fastened to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:

a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

1) GEMCO; Nylon Hangers.

2) Midwest Fasteners, Inc.; Nylon Insulation Hangers.

3) AGM Industries, Inc.; Tactoo Insul-Hangers, Series TSA.

b. Baseplate: Perforated, nylon sheet, 0.030 inch (0.76 mm) thick by 1-1/2 inches (38 mm) in diameter.

c. Spindle: Nylon, 0.106-inch- (2.6-mm-) diameter shank, length to suit depth of insulation indicated, up to 2-1/2 inches (63 mm).

d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.

3. Self-Sticking-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:

a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

1) AGM Industries, Inc.; Tactoo Insul-Hangers, Series TSA.

2) GEMCO; Press and Peel.

3) Midwest Fasteners, Inc.; Self Stick.

b. Baseplate: Galvanized carbon-steel sheet, 0.030 inch (0.76 mm) thick by 2 inches (50 mm) square.

c. Spindle: Copper- or zinc-coated, low carbon steel, fully annealed, 0.106-inch- (2.6-mm-) diameter shank, length to suit depth of insulation indicated.

d. Adhesive-backed base with a peel-off protective cover.

4. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- (0.41-mm-) thick, aluminum sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches (38 mm) in diameter.

a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

1) AGM Industries, Inc.; RC-150.

2) GEMCO; R-150.

3) Midwest Fasteners, Inc.; WA-150.

4) Nelson Stud Welding; Speed Clips.

b. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.

5. Nonmetal Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- (0.41-mm-) thick nylon sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches (38 mm) in diameter.

a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

1) GEMCO.

2) Midwest Fasteners, Inc.

3) AGM Industries, Inc.; Tactoo Insul-Hangers, Series TSA.

C. Staples: Outward-clinching insulation staples, nominal 3/4-inch- (19-mm-) wide, stainless steel or Monel.

D. Wire: 0.062-inch (1.6-mm) soft-annealed, galvanized steel.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. C & F Wire.

b. Childers Products.

c. PABCO Metals Corporation.

d. RPR Products, Inc.

2.011 CORNER ANGLES

A. PVC Corner Angles: 30 mils (0.8 mm) thick, minimum 1 by 1 inch (25 by 25 mm), PVC according to ASTM D 1784, Class 16354-C. White or color-coded to match adjacent surface.

B. Aluminum Corner Angles: 0.040 inch (1.0 mm) thick, minimum 1 by 1 inch (25 by 25 mm), aluminum according to ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105 or 5005; Temper H-14.

PART 3 - EXECUTION

3.01 PREPARATION

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

B. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.

C. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.02 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of equipment and piping including fittings, valves, and specialties.

B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of equipment and pipe system as specified in insulation system schedules.

C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

D. Install insulation with longitudinal seams at top and bottom of horizontal runs.

E. Install multiple layers of insulation with longitudinal and end seams staggered.

F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.

G. Keep insulation materials dry during application and finishing.

H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

I. Install insulation with least number of joints practical.

J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.

1. Install insulation continuously through hangers and around anchor attachments.
2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.

K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

L. Install insulation with factory-applied jackets as follows:

1. Draw jacket tight and smooth.
2. Cover circumferential joints with 3-inch- (75-mm-) wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches (100 mm) o.c.

3. Overlap jacket longitudinal seams at least 1-1/2 inches (38 mm). Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches (50 mm) o.c.
    a. For below ambient services, apply vapor-barrier mastic over staples.
4. Cover joints and seams with tape as recommended by insulation material manufacturer to maintain vapor seal.
5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.

M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches (100 mm) beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

P. For above ambient services, do not install insulation to the following:
1. Vibration-control devices.
2. Testing agency labels and stamps.
3. Nameplates and data plates.
4. Manholes.
5. Handholes.
6. Cleanouts.

3.03 PENETRATIONS

A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches (50 mm) below top of roof flashing.
4. Seal jacket to roof flashing with flashing sealant.

B. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.

C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches (50 mm).
4. Seal jacket to wall flashing with flashing sealant.

D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

E. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.
1. Comply with requirements in Division 07 Section "Penetration Firestopping"irestopping and fire-resistive joint sealers.

F. Insulation Installation at Floor Penetrations:

1. Pipe: Install insulation continuously through floor penetrations.
2. Seal penetrations through fire-rated assemblies. Comply with requirements in Division 07 Section "Penetration Firestopping."

3.04 EQUIPMENT, TANK, AND VESSEL INSULATION INSTALLATION

A. Mineral Fiber, Pipe and Tank Insulation Installation for Tanks and Vessels: Secure insulation with adhesive and anchor pins and speed washers.

1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of tank and vessel surfaces.
2. Groove and score insulation materials to fit as closely as possible to equipment, including contours. Bevel insulation edges for cylindrical surfaces for tight joints. Stagger end joints.
3. Protect exposed corners with secured corner angles.
4. Install adhesively attached or self-sticking insulation hangers and speed washers on sides of tanks and vessels as follows:
    a. Do not weld anchor pins to ASME-labeled pressure vessels.
    b. Select insulation hangers and adhesive that are compatible with service temperature and with substrate.
    c. On tanks and vessels, maximum anchor-pin spacing is 3 inches (75 mm) from insulation end joints, and 16 inches (400 mm) o.c. in both directions.
    d. Do not overcompress insulation during installation.
    e. Cut and miter insulation segments to fit curved sides and domed heads of tanks and vessels.
    f. Impale insulation over anchor pins and attach speed washers.
    g. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
5. Secure each layer of insulation with stainless-steel or aluminum bands. Select band material compatible with insulation materials.
6. Where insulation hangers on equipment and vessels are not permitted or practical and where insulation support rings are not provided, install a girdle network for securing insulation. Stretch prestressed aircraft cable around the diameter of vessel and make taut with clamps, turnbuckles, or breather springs. Place one circumferential girdle around equipment approximately 6 inches (150 mm) from each end. Install wire or cable between two circumferential girdles 12 inches (300 mm) o.c. Install a wire ring around each end and around outer periphery of center openings, and stretch prestressed aircraft cable radially from the wire ring to nearest circumferential girdle. Install additional circumferential girdles along the body of equipment or tank at a minimum spacing of 48 inches (1200 mm) o.c. Use this network for securing insulation with tie wire or bands.
7. Stagger joints between insulation layers at least 3 inches (75 mm).
8. Install insulation in removable segments on equipment access doors, manholes, handholes, and other elements that require frequent removal for service and inspection.
9. Bevel and seal insulation ends around manholes, handholes, ASME stamps, and nameplates.
10. For equipment with surface temperatures below ambient, apply mastic to open ends, joints, seams, breaks, and punctures in insulation.

B. Flexible Elastomeric Thermal Insulation Installation for Tanks and Vessels: Install insulation over entire surface of tanks and vessels.

1. Apply 100 percent coverage of adhesive to surface with manufacturer's recommended adhesive.
2. Seal longitudinal seams and end joints.

3.05 GENERAL PIPE INSULATION INSTALLATION

A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.

B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:

1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity, unless otherwise indicated.
2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below ambient services, provide a design that maintains vapor barrier.
6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below ambient services and a breather mastic for above ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
8. For services not specified to receive a field-applied jacket except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
9. Stencil or label the outside insulation jacket of each union with the word "UNION." Match size and color of pipe labels.

C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes, vessels, and equipment. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.

D. Install removable insulation covers at locations indicated. Installation shall conform to the following:

1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.
3. Construct removable valve insulation covers in same manner as for flanges except divide the two-part section on the vertical center line of valve body.
4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches (50 mm) over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.

5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

3.06 CELLULAR-GLASS INSULATION INSTALLATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above ambient services, secure laps with outward clinched staples at 6 inches (150 mm) o.c.
4. For insulation with factory-applied jackets on below ambient services, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of cellular-glass block insulation of same thickness as pipe insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch (25 mm), and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
2. When preformed sections of insulation are not available, install mitered sections of cellular-glass insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of cellular-glass insulation to valve body.
2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.

3.07 FLEXIBLE ELASTOMERIC INSULATION INSTALLATION

A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

B. Insulation Installation on Pipe Flanges:

1. Install pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation.
4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install mitered sections of pipe insulation.
2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed valve covers manufactured of same material as pipe insulation when available.

2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.

3. Install insulation to flanges as specified for flange insulation application.

4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.08 POLYOLEFIN INSULATION INSTALLATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Seal split-tube longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

B. Insulation Installation on Pipe Flanges:

1. Install pipe insulation to outer diameter of pipe flange.

2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.

3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of polyolefin sheet insulation of same thickness as pipe insulation.

4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install mitered sections of polyolefin pipe insulation.

2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install cut sections of polyolefin pipe and sheet insulation to valve body.

2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.

3. Install insulation to flanges as specified for flange insulation application.

4. Secure insulation to valves and specialties, and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.09 POLYSTYRENE INSULATION INSTALLATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of insulation with tape or bands and tighten bands without deforming insulation materials. Orient longitudinal joints between half sections in 3 and 9 o'clock positions on the pipe.

2. For insulation with factory-applied jackets with vapor barriers, do not staple longitudinal tabs but secure tabs with additional adhesive or tape as recommended by insulation material manufacturer and seal with vapor-barrier mastic.

3. All insulation shall be tightly butted and free of voids and gaps at all joints. Vapor barrier must be continuous. Before installing jacket material, install vapor-barrier system.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.

2. Make width of insulation section same as overall width of flange and bolts, same thickness of adjacent pipe insulation, not to exceed 1-1/2-inch (38-mm) thickness.

3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of polystyrene block insulation of same thickness as pipe insulation.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed insulation sections of same material as straight segments of pipe insulation. Secure according to manufacturer's written instructions.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed section of polystyrene insulation to valve body.
2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.

3.010 FIELD-APPLIED JACKET INSTALLATION

A. Where FSK jackets are indicated, install as follows:

1. Draw jacket material smooth and tight.
2. Install lap or joint strips with same material as jacket.
3. Secure jacket to insulation with manufacturer's recommended adhesive.
4. Install jacket with 1-1/2-inch (38-mm) laps at longitudinal seams and 3-inch- (75-mm-) wide joint strips at end joints.
5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.

B. Where PVC jackets are indicated, install with 1-inch (25-mm) overlap at longitudinal seams and end joints; for horizontal applications, install with longitudinal seams along top and bottom of tanks and vessels. Seal with manufacturer's recommended adhesive.

1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

C. Where metal jackets are indicated, install with 2-inch (50-mm) 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 (300 mm) o.c. and at end joints.

D. Where PVDC jackets are indicated, install as follows:

1. Apply three separate wraps of filament tape per insulation section to secure pipe insulation to pipe prior to installation of PVDC jacket.
2. Wrap factory-presized jackets around individual pipe insulation sections with one end overlapping the previously installed sheet. Install presized jacket with an approximate overlap at butt joint of 2 inches (50 mm) over the previous section. Adhere lap seal using adhesive or SSL, and then apply 1-1/4 circumferences of appropriate PVDC tape around overlapped butt joint.
3. Continuous jacket can be spiral wrapped around a length of pipe insulation. Apply adhesive or PVDC tape at overlapped spiral edge. When electing to use adhesives, refer to manufacturer's written instructions for application of adhesives along this spiral edge to maintain a permanent bond.
4. Jacket can be wrapped in cigarette fashion along length of roll for insulation systems with an outer circumference of 33-1/2 inches (850 mm) or less. The 33-1/2-inch- (850-mm-) circumference limit allows for 2-inch- (50-mm-) overlap seal. Using the length of roll allows for longer sections of jacket to be installed at one time. Use adhesive on the lap seal. Visually inspect lap seal for "fishmouthing," and use PVDC tape along lap seal to secure joint.
5. Repair holes or tears in PVDC jacket by placing PVDC tape over the hole or tear and wrapping a minimum of 1-1/4 circumferences to avoid damage to tape edges.

3.011 FINISHES

A. Equipment and Pipe Insulation with ASJ or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Division 09 painting Sections.

1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.
    a. Finish Coat Material: Interior, flat, latex-emulsion size.

B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.

C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.

D. Do not field paint aluminum or stainless-steel jackets.

3.012 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:

1. Inspect field-insulated equipment, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to one location(s) for each type of equipment defined in the "Equipment Insulation Schedule" Article. For large equipment, remove only a portion adequate to determine compliance.

2. Inspect pipe, fittings, strainers, and valves, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to three locations of straight pipe, three locations of threaded fittings, three locations of welded fittings, two locations of threaded strainers, two locations of welded strainers, three locations of threaded valves, and three locations of flanged valves for each pipe service defined in the "Piping Insulation Schedule, General" Article.

C. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.013 DOMESTIC WATER BOILER BREECHING INSULATION SCHEDULE

A. Round, Exposed Breeching and Connector Insulation: High-temperature mineral-fiber blanket, 3 inches (75 mm) thick and 3-lb/cu. ft. (48-kg/cu. m) nominal density.

B. Round, Concealed Breeching and Connector Insulation: High-temperature mineral-fiber blanket, 3 inches (75 mm) thick and 3-lb/cu. ft. (48-kg/cu. m) nominal density.

3.014 EQUIPMENT INSULATION SCHEDULE

A. Insulation materials and thicknesses are identified below. If more than one material is listed for a type of equipment, selection from materials listed is Contractor's option.

B. Insulate indoor and outdoor equipment in paragraphs below that is not factory insulated.

C. Heat-Exchanger (Water-to-Water for Domestic Water Heating Service) Insulation: Mineral-Fiber Pipe and Tank: 2 inches (50 mm) thick.

D. Domestic water, domestic chilled-water (potable), and domestic hot-water hydropneumatic tank insulation shall be one of the following:

1. Flexible Elastomeric: 1 inch (25 mm) thick.

2. Mineral-Fiber Pipe and Tank: 1 inch (25 m m) thick.

3. Polyolefin: 1 inch (25 mm) thick.

E. Domestic Hot-Water Storage Tank Insulation: Mineral-Fiber Pipe and Tank: Of thickness to provide an R-value of 12.5.

F. Piping System Filter-Housing Insulation: Mineral-Fiber Pipe and Tank: 2 inches (50 mm) thick.

3.015 PIPING INSULATION SCHEDULE, GENERAL

A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.

B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:

1. Drainage piping located in crawl spaces.

2. Underground piping.

3. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

3.016 INDOOR PIPING INSULATION SCHEDULE

A. Domestic Cold, Hot, and Recirculated Hot Water: Insulation shall be the following:

1. Flexible Elastomeric: 1 inch (25 mm) thick.

2. Mineral-Fiber, Preformed Pipe Insulation, Type I: 2 inch (50 mm) thick.

3. Polyolefin: 1 inch (25 mm) thick.

B. Domestic Chilled Water (Potable): Insulation shall be the following:

1. Flexible Elastomeric: 1 inch (25 mm) thick.
2. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch (25 mm) thick.
3. Polyolefin: 1 inch (25 mm) thick.

C. Stormwater and Overflow: Insulation shall be one of the following:

1. Flexible Elastomeric: 1 inch (25 mm) thick.
2. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch (25 mm) thick.
3. Polyolefin: 1 inch (25 mm) thick.

D. Roof Drain and Overflow Drain Bodies: Insulation shall be one of the following:

1. Flexible Elastomeric: 1 inch (25 mm) thick.
2. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch (25 mm) thick.
3. Polyolefin: 1 inch (25 mm) thick.

E. Exposed Sanitary Drains, Domestic Water, Domestic Hot Water, and Stops for Plumbing Fixtures for People with Disabilities: Insulation shall be one of the following:

1. Flexible Elastomeric: 1/2 inch (13 mm) thick.
2. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1/2 inch (13 mm) thick.
3. Polyolefin: 1/2 inch (13 mm) thick.

F. Sanitary Waste Piping Where Heat Tracing Is Installed: Insulation shall be one of the following:

1. Cellular Glass: 2 inches (50 mm) thick.
2. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1-1/2 inches (38 mm) thick.

3.017 OUTDOOR, ABOVEGROUND PIPING INSULATION SCHEDULE

A. Domestic Water Piping: Insulation shall be the following:

1. Cellular Glass: 2 inches (50 mm) thick.
2. Flexible Elastomeric: 2 inches (50 mm) thick.
3. Mineral-Fiber, Preformed Pipe Insulation, Type I: 2 inches (50 mm) thick.
4. Polyolefin: 2 inches (50 mm) thick.
5. Polystyrene: 2 inches (50 mm) thick.

B. Domestic Hot and Recirculated Hot Water: Insulation shall be the following:

1. Cellular Glass: 2 inches (50 mm) thick.
2. Flexible Elastomeric: 2 inches (50 mm) thick.
3. Mineral-Fiber, Preformed Pipe Insulation, Type I: 2 inches (50 mm) thick.
4. Polyolefin: 2 inches (50 mm) thick.

C. Sanitary Waste Piping Where Heat Tracing Is Installed: Insulation shall be the following:

1. Cellular Glass: 2 inches (50 mm) thick.
2. Mineral-Fiber, Preformed Pipe Insulation, Type I: 2 inches (50 mm) thick.

3.018 OUTDOOR, UNDERGROUND PIPING INSULATION SCHEDULE

A. Loose-fill insulation, for belowground piping, is specified in Division 33 piping distribution Sections.

B. Sanitary Waste Piping, All Sizes, Where Heat Tracing Is Installed: Cellular glass, 2 inches (50 mm) thick.

3.019 INDOOR, FIELD-APPLIED JACKET SCHEDULE

A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

B. If more than one material is listed, selection from materials listed is Contractor's option.

C. Equipment, Concealed:

1. None.
2. PVC: 20 mils (0.5 mm) thick.
3. Aluminum, Smooth: 0.020 inch (0.51 mm) thick.

D. Equipment, Exposed, up to 48 Inches (1200 mm) in Diameter or with Flat Surfaces up to 72 Inches (1800 mm):

1. None.
2. PVC: 20 mils (0.5 mm) thick.
3. Aluminum, Smooth: 0.020 inch (0.51 mm) thick.

E. Equipment, Exposed, Larger Than 48 Inches (1200 mm) in Diameter or with Flat Surfaces Larger Than 72 Inches (1800 mm):

1. None.
2. Painted Aluminum, with 2-1/2-Inch- (65-mm-) Deep Corrugations: 0.032 inch (0.81 mm) thick.

F. Piping, Concealed:

1. None.
2. PVC: 30 mils (0.8 mm) thick.
3. Aluminum, Smooth: 0.032 inch (0.81 mm) thick.

G. Piping, Exposed:

1. None.
2. PVC: 30 mils (0.8 mm) thick.
3. Aluminum, Smooth: 0.032 inch (0.81 mm) thick.

3.020 UNDERGROUND, FIELD-INSTALLED INSULATION JACKET

A. For underground direct-buried piping applications, install underground direct-buried jacket over insulation material.

END OF SECTION 22 0700

SECTION 22 1116
DOMESTIC WATER PIPING

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Under-building slab and aboveground domestic water pipes, tubes, fittings, and specialties inside the building.
2. Encasement for piping.
3. Specialty valves.
4. Flexible connectors.
5. Water meters furnished by utility company for installation by Contractor.
6. Escutcheons.
7. Sleeves and sleeve seals.
8. Wall penetration systems.

B. Related Section:

1. Division 22 Section "Facility Water Distribution Piping" for water-service piping and water meters outside the building from source to the point where water-service piping enters the building.

1.02 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Domestic water piping and support and installation shall withstand effects of earthquake motions determined according to ASCE/SEI 7.

1.03 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Field quality-control reports.

1.04 QUALITY ASSURANCE

A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

B. Comply with NSF 14 for plastic, potable domestic water piping and components. Include marking "NSF-pw" on piping.

C. Comply with NSF 61 for potable domestic water piping and components.

PART 2 - PRODUCTS

2.01 PIPING MATERIALS

A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

2.02 COPPER TUBE AND FITTINGS

A. Hard Copper Tube: ASTM B 88, Type L (ASTM B 88M, Type B) water tube, drawn temper.

B. Soft Copper Tube: ASTM B 88, Type K (ASTM B 88M, Type A) water tube, annealed temper.

2.03 DUCTILE-IRON PIPE AND FITTINGS

A. Push-on-Joint, Ductile-Iron Pipe: AWWA C151, with push-on-joint bell and plain spigot end unless grooved or flanged ends are indicated.

a. Gaskets: AWWA C111, rubber.

b. Gaskets: AWWA C111, rubber.

2.04 PVC PIPE AND FITTINGS

A. PVC Pipe: ASTM D 1785, Schedule 40 and Schedule 80.

2.05 PIPING JOINING MATERIALS

A. Pipe-Flange Gasket Materials: AWWA C110, rubber, flat face, 1/8 inch (3.2 mm) thick or ASME B16.21, nonmetallic and asbestos free, unless otherwise indicated; full-face or ring type unless otherwise indicated.

B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.

C. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

D. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.

E. Solvent Cements for Joining PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.

F. Plastic, Pipe-Flange Gaskets, Bolts, and Nuts: Type and material recommended by piping system manufacturer unless otherwise indicated.

2.06 TRANSITION FITTINGS

A. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.

B. Sleeve-Type Transition Coupling: AWWA C219.

C. Plastic-to-Metal Transition Fittings:

D. Plastic-to-Metal Transition Unions:

2.07 DIELECTRIC FITTINGS

A. General Requirements: Assembly of copper alloy and ferrous materials or ferrous material body with separating nonconductive insulating material suitable for system fluid, pressure, and temperature.

B. Dielectric Unions:

   a. Pressure Rating: 150 psig (1035 kPa) at 180 deg F (82 deg C).

   b. End Connections: Solder-joint copper alloy and threaded ferrous.

C. Dielectric Flanges:

   a. Factory-fabricated, bolted, companion-flange assembly.

   b. Pressure Rating: 150 psig (1035 kPa).

   c. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

D. Dielectric-Flange Kits:

   a. Nonconducting materials for field assembly of companion flanges.

   b. Pressure Rating: 150 psig (1035 kPa).

   c. Gasket: Neoprene or phenolic.

   d. Bolt Sleeves: Phenolic or polyethylene.

   e. Washers: Phenolic with steel backing washers.

E. Dielectric Couplings:

   a. Galvanized-steel coupling.

   b. Pressure Rating: 300 psig (2070 kPa) at 225 deg F (107 deg C).

   c. End Connections: Female threaded.

   d. Lining: Inert and noncorrosive, thermoplastic.

F. Dielectric Nipples:

   a. Electroplated steel nipple complying with ASTM F 1545.

b. Pressure Rating: 300 psig (2070 kPa) at 225 deg F (107 deg C).

c. End Connections: Male threaded or grooved.

d. Lining: Inert and noncorrosive, propylene.

2.08 FLEXIBLE CONNECTORS

A. Bronze-Hose Flexible Connectors: Corrugated-bronze tubing with bronze wire-braid covering and ends brazed to inner tubing.

B. Stainless-Steel-Hose Flexible Connectors: Corrugated-stainless-steel tubing with stainless-steel wire-braid covering and ends welded to inner tubing.

2.09 WATER METERS

A. Displacement-Type Water Meters:

a. Standard: AWWA C700.

b. Pressure Rating: 150-psig (1035-kPa) working pressure.

c. Body Design: Nutating disc; totalization meter.

d. Registration: In gallons (liters) or cubic feet (cubic meters) as required by utility.

e. Case: Bronze.

f. End Connections: Threaded.

B. Compound-Type Water Meters:

a. Standard: AWWA C702.

b. Pressure Rating: 150-psig (1035-kPa) working pressure.

c. Body Design: With integral mainline and bypass meters; totalization meter.

d. Registration: In gallons (liters) or cubic feet (cubic meters) as required by utility company.

e. Case: Bronze.

f. Pipe Connections: Flanged.

C. Remote Registration System: Encoder type complying with AWWA C707; modified with signal transmitting assembly, low-voltage connecting wiring, and remote register assembly as required by utility company.

2.010 ESCUTCHEONS

A. General: Manufactured ceiling, floor, and wall escutcheons and floor plates.

B. One Piece, Cast Brass: Polished, chrome-plated finish with setscrews.

C. One Piece, Deep Pattern: Deep-drawn, box-shaped brass with chrome-plated finish.

D. One Piece, Stamped Steel: Chrome-plated finish with spring clips.

E. Split Casting, Cast Brass: Polished, chrome-plated finish with concealed hinge and setscrew.

F. Split Plate, Stamped Steel: Chrome-plated finish with concealed hinge, setscrew or spring clips.

G. One-Piece Floor Plates: Cast-iron flange with holes for fasteners.

H. Split-Casting Floor Plates: Cast brass with concealed hinge.

2.011 SLEEVES

A. Cast-Iron Wall Pipes: Fabricated of cast iron, and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.

B. Galvanized-Steel-Sheet Sleeves: 0.0239-inch (0.6-mm) minimum thickness; round tube closed with welded longitudinal joint.

C. PVC-Pipe Sleeves: ASTM D 1785, Schedule 40.

D. Galvanized-Steel-Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc-coated, with plain ends.

E. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.

2.012 SLEEVE SEALS

A. Description: Modular sealing element unit, designed for field assembly, used to fill annular space between pipe and sleeve.

2.013 GROUT

A. Standard: ASTM C 1107, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.

B. Characteristics: Nonshrink; recommended for interior and exterior applications.

C. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.

D. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.01 EARTHWORK

A. Comply with requirements in Division 31 Section "Earth Moving" for excavating, trenching, and backfilling.

3.02 PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of domestic water piping. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

B. Install copper tubing under building slab according to CDA's "Copper Tube Handbook."

C. Install ductile-iron piping under building slab with restrained joints according to AWWA C600 and AWWA M41.

D. Install shutoff valve, hose-end drain valve, strainer, pressure gage, and test tee with valve, inside the building at each domestic water service entrance. Comply with requirements in Division 22 Section "Meters and Gages for Plumbing Piping" for pressure gages and Division 22 Section "Domestic Water Piping Specialties" for drain valves and strainers.

E. Install shutoff valve immediately upstream of each dielectric fitting.

F. Install water-pressure-reducing valves downstream from shutoff valves. Comply with requirements in Division 22 Section "Domestic Water Piping Specialties" for pressure-reducing valves.

G. Install domestic water piping level without pitch and plumb.

H. Rough-in domestic water piping for water-meter installation according to utility company's requirements.

I. Install seismic restraints on piping. Comply with requirements in Division 22 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment" for seismic-restraint devices.

J. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.

K. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

L. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.

M. Install piping adjacent to equipment and specialties to allow service and maintenance.

N. Install piping to permit valve servicing.

O. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than system pressure rating used in applications below unless otherwise indicated.

P. Install piping free of sags and bends.

Q. Install fittings for changes in direction and branch connections.

R. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.

S. Install pressure gages on suction and discharge piping from each plumbing pump and packaged booster pump. Comply with requirements in Division 22 Section "Meters and Gages for Plumbing Piping" for pressure gages.

T. Install thermostats in hot-water circulation piping. Comply with requirements in Division 22 Section "Domestic Water Pumps" for thermostats.

U. Install thermometers on inlet and outlet piping from each water heater. Comply with requirements in Division 22 Section "Meters and Gages for Plumbing Piping" for thermometers.

3.03 JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

B. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.

C. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.

D. Brazed Joints: Join copper tube and fittings according to CDA's "Copper Tube Handbook," "Brazed Joints" Chapter.

E. Soldered Joints: Apply ASTM B 813, water-flushable flux to end of tube. Join copper tube and fittings according to ASTM B 828 or CDA's "Copper Tube Handbook."

F. Flanged Joints: Select appropriate asbestos-free, nonmetallic gasket material in size, type, and thickness suitable for domestic water service. Join flanges with gasket and bolts according to ASME B31.9.

G. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:

H. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.

3.04 VALVE INSTALLATION

A. General-Duty Valves: Comply with requirements in Division 22 Section "General-Duty Valves for Plumbing Piping" for valve installations.

B. Install shutoff valve close to water main on each branch and riser serving plumbing fixtures or equipment, on each water supply to equipment, and on each water supply to plumbing fixtures that do not have supply stops. Use ball or gate valves for piping NPS 2 (DN 50) and smaller. Use butterfly or gate valves for piping NPS 2-1/2 (DN 65) and larger.

C. Install drain valves for equipment at base of each water riser, at low points in horizontal piping, and where required to drain water piping. Drain valves are specified in Division 22 Section "Domestic Water Piping Specialties."

1. Hose-End Drain Valves: At low points in water mains, risers, and branches.

D. Install balancing valve in each hot-water circulation return branch and discharge side of each pump and circulator. Set balancing valves partly open to restrict but not stop flow. Use ball valves for piping NPS 2 (DN 50) and smaller and butterfly valves for piping NPS 2-1/2 (DN 65)

and larger. Comply with requirements in Division 22 Section "Domestic Water Piping Specialties" for balancing valves.

3.05 TRANSITION FITTING INSTALLATION

A. Install transition couplings at joints of dissimilar piping.

B. Transition Fittings in Underground Domestic Water Piping:

C. Transition Fittings in Aboveground Domestic Water PipingNPS 2 (DN 50) and Smaller: Plastic-to-metal transition fittings.

3.06 DIELECTRIC FITTING INSTALLATION

A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.

B. Dielectric Fittings for NPS 2 (DN 50) and Smaller: Use dielectric couplings or nipples.

C. Dielectric Fittings for NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Use dielectric flange kits.

3.07 FLEXIBLE CONNECTOR INSTALLATION

A. Install flexible connectors in suction and discharge piping connections to each domestic water pump and in suction and discharge manifold connections to each domestic water booster pump.

B. Install bronze-hose flexible connectors in copper domestic water tubing.

C. Install stainless-steel-hose flexible connectors in steel domestic water piping.

3.08 WATER METER INSTALLATION

A. Rough-in domestic water piping , and install water meters according to utility company's requirements.

B. Water meters will be furnished and installed by utility company.

C. Install water meters according to AWWA M6, utility company's requirements, and the following:

D. Install displacement-type water meters with shutoff valve on water-meter inlet. Install valve on water-meter outlet and valved bypass around meter unless prohibited by authorities having jurisdiction.

E. Install compound-type water meters with shutoff valves on water-meter inlet and outlet and on valved bypass around meter. Support meters, valves, and piping on brick or concrete piers.

F. Install remote registration system according to standards of utility company and of authorities having jurisdiction.

3.09 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements in Division 22 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment" for seismic-restraint devices.

B. Comply with requirements in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment" for pipe hanger and support products and installation.

1. Vertical Piping: MSS Type 8 or 42, clamps.
2. Individual, Straight, Horizontal Piping Runs:
    a. 100 Feet (30 m) and Less: MSS Type 1, adjustable, steel clevis hangers.
    b. Longer Than 100 Feet (30 m): MSS Type 43, adjustable roller hangers.
    c. Longer Than 100 Feet (30 m) If Indicated: MSS Type 49, spring cushion rolls.
3. Multiple, Straight, Horizontal Piping Runs 100 Feet (30 m) or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
4. Base of Vertical Piping: MSS Type 52, spring hangers.

C. Support vertical piping and tubing at base and at each floor.

D. Rod diameter may be reduced one size for double-rod hangers, to a minimum of 3/8 inch (10 mm).

E. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 3/4 (DN 20) and Smaller: 60 inches (1500 mm) with 3/8-inch (10-mm) rod.
2. NPS 1 and NPS 1-1/4 (DN 25 and DN 32): 72 inches (1800 mm) with 3/8-inch (10-mm) rod.
3. NPS 1-1/2 and NPS 2 (DN 40 and DN 50): 96 inches (2400 mm) with 3/8-inch (10-mm) rod.
4. NPS 2-1/2 (DN 65): 108 inches (2700 mm) with 1/2-inch (13-mm) rod.
5. NPS 3 to NPS 5 (DN 80 to DN 125): 10 feet (3 m) with 1/2-inch (13-mm) rod.

F. Install supports for vertical copper tubing every 10 feet (3 m).

G. Install hangers for steel piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/4 (DN 32) and Smaller: 84 inches (2100 mm) with 3/8-inch (10-mm) rod.
2. NPS 1-1/2 (DN 40): 108 inches (2700 mm) with 3/8-inch (10-mm) rod.
3. NPS 2 (DN 50): 10 feet (3 m) with 3/8-inch (10-mm) rod.
4. NPS 2-1/2 (DN 65): 11 feet (3.4 m) with 1/2-inch (13-mm) rod.
5. NPS 3 and NPS 3-1/2 (DN 80 and DN 90): 12 feet (3.7 m) with 1/2-inch (13-mm) rod.
6. NPS 4 and NPS 5 (DN 100 and DN 125): 12 feet (3.7 m) with 5/8-inch (16-mm) rod.
7. NPS 6 (DN 150): 12 feet (3.7 m) with 3/4-inch (19-mm) rod.

H. Install supports for vertical steel piping every 15 feet (4.5 m).

I. Support piping and tubing not listed in this article according to MSS SP-69 and manufacturer's written instructions.

3.010 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 piping to exterior water-service piping. Use transition fitting to join dissimilar piping materials.

D. Connect domestic water piping to water-service piping with shutoff valve; extend and connect to the following:

1. Domestic Water Booster Pumps: Cold-water suction and discharge piping.
2. Water Heaters: Cold-water inlet and hot-water outlet piping in sizes indicated, but not smaller than sizes of water heater connections.
3. Plumbing Fixtures: Cold- and hot-water supply piping in sizes indicated, but not smaller than required by plumbing code. Comply with requirements in Division 22 plumbing fixture Sections for connection sizes.
4. Equipment: Cold- and hot-water supply piping as indicated, but not smaller than equipment connections. Provide shutoff valve and union for each connection. Use flanges instead of unions for NPS 2-1/2 (DN 65) and larger.

3.011 ESCUTCHEON INSTALLATION

A. Install escutcheons for penetrations of walls, ceilings, and floors.

B. Escutcheons for New Piping:

1. Piping with Fitting or Sleeve Protruding from Wall: One piece, deep pattern.
2. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One piece, stamped steel with set screw or spring clips.

3. Bare Piping at Ceiling Penetrations in Finished Spaces: One piece or split plate, stamped steel with set screw.
4. Bare Piping in Unfinished Service Spaces: One piece, stamped steel with set screw or spring clips.
5. Bare Piping in Equipment Rooms: One piece, stamped steel with set screw or spring clips.
6. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece floor plate.

3.012 SLEEVE INSTALLATION

A. General Requirements: Install sleeves for pipes and tubes passing through penetrations in floors, partitions, roofs, and walls.

B. Sleeves are not required for core-drilled holes.

C. Permanent sleeves are not required for holes formed by removable PE sleeves.

D. Cut sleeves to length for mounting flush with both surfaces unless otherwise indicated.

E. Install sleeves in new partitions, slabs, and walls as they are built.

F. For interior wall penetrations, seal annular space between sleeve and pipe or pipe insulation using joint sealants appropriate for size, depth, and location of joint. Comply with requirements in Division 07 Section "Joint Sealants" for joint sealants.

G. For exterior wall penetrations above grade, seal annular space between sleeve and pipe using joint sealants appropriate for size, depth, and location of joint. Comply with requirements in Division 07 Section "Joint Sealants" for joint sealants.

H. For exterior wall penetrations below grade, seal annular space between sleeve and pipe using sleeve seals specified in this Section.

I. Seal space outside of sleeves in concrete slabs and walls with grout.

J. Install sleeves that are large enough to provide 1/4-inch (6.4-mm) annular clear space between sleeve and pipe or pipe insulation unless otherwise indicated.

K. Install sleeve materials according to the following applications:

1. Sleeves for Piping Passing through Concrete Floor Slabs: Steel pipe.
2. Sleeves for Piping Passing through Concrete Floor Slabs of Mechanical Equipment Areas or Other Wet Areas: Steel pipe.
    a. Extend sleeves 2 inches (50 mm above finished floor level.
    b. For pipes penetrating floors with membrane waterproofing, extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches (50 mm) above finished floor level. Comply with requirements in Division 07 Section "Sheet Metal Flashing and Trim" for flashing.
3. Sleeves for Piping Passing through Gypsum-Board Partitions:
    a. Steel pipe sleeves for pipes smaller than NPS 6 (DN 150).
    b. Galvanized-steel sheet sleeves for pipes NPS 6 (DN 150) and larger.
    c. Exception: Sleeves are not required for water supply tubes and waste pipes for individual plumbing fixtures if escutcheons will cover openings.
4. Sleeves for Piping Passing through Concrete Roof Slabs: Steel pipe.
5. Sleeves for Piping Passing through Exterior Concrete Walls:
    a. Steel pipe sleeves for pipes smaller than NPS 6 (DN 150).
    b. Cast-iron wall pipe sleeves for pipes NPS 6 (DN 150) and larger.
    c. Install sleeves that are large enough to provide 1-inch (25-mm) annular clear space between sleeve and pipe or pipe insulation when sleeve seals are used.

d. Do not use sleeves when wall penetration systems are used.

6. Sleeves for Piping Passing through Interior Concrete Walls:

a. Steel pipe sleeves for pipes smaller than NPS 6 (DN 150).

b. Galvanized-steel sheet sleeves for pipes NPS 6 (DN 150) and larger.

L. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements in Division 07 Section "Penetration Firestopping" for firestop materials and installations.

3.013 SLEEVE SEAL INSTALLATION

A. Install sleeve seals in sleeves in exterior concrete walls at water-service piping entries into building.

B. Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble sleeve seal components and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.014 IDENTIFICATION

A. Identify system components. Comply with requirements in Division 22 Section "Identification for Plumbing Piping and Equipment" for identification materials and installation.

B. Label pressure piping with system operating pressure.

3.015 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Piping Inspections:

a. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.

b. Final Inspection: Arrange final inspection for authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.

C. Piping Tests:

D. Domestic water piping will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

3.016 CLEANING

A. Clean and disinfect potable domestic water piping as follows:

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. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.

B. Prepare and submit reports of purging and disinfecting activities.

C. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

3.017 PIPING SCHEDULE

A. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.

B. Flanges and unions may be used for aboveground piping joints unless otherwise indicated.

C. Under-building-slab, domestic water, building service piping, NPS 3 (DN 80) and smaller, shall be one of the following:

1. Soft copper tube, ASTM B 88, Type K (ASTM B 88M, Type A); wrought-copper solder-joint fittings; and brazed joints.
2. PVC, Schedule 40 pipe; PVC, Schedule 40 socket fittings; and solvent-cemented joints.

D. Under-building-slab, domestic water, building-service piping, NPS 4 to NPS 8 (DN 100 to DN 200) and larger, shall be one of the following:

1. Soft copper tube, ASTM B 88, Type K (ASTM B 88M, Type A; wrought-copper solder-joint fittings; and brazed joints.
2. Mechanical-joint, ductile-iron pipe; standard- or compact- pattern mechanical-joint fittings; and mechanical joints.
3. Plain-end, ductile-iron pipe; grooved-joint, ductile-iron-pipe appurtenances; and grooved joints.
4. PVC, Schedule 40 pipe; PVC, Schedule 40 socket fittings; and solvent-cemented joints.

E. Aboveground domestic water piping, NPS 2 (DN 50) and smaller, shall be the following:

1. Hard copper tube, ASTM B 88, Type L (ASTM B 88M, Type B; cast- or wrought- copper solder-joint fittings; and soldered joints.

F. Aboveground domestic water piping, NPS 2-1/2 to NPS 4 (DN 65 to DN 100), shall be the following:

1. Hard copper tube, ASTM B 88, Type L (ASTM B 88M, Type B; wrought- copper solder-joint fittings; and brazed joints.

3.018 VALVE SCHEDULE

A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:

1. Shutoff Duty: Use ball or gate valves for piping NPS 2 (DN 50) and smaller. Use butterfly, ball, or gate valves with flanged ends for piping NPS 2-1/2 (DN 65) and larger.
2. Throttling Duty: Use ball or globe valves for piping NPS 2 (DN 50) and smaller. Use butterfly or ball valves with flanged ends for piping NPS 2-1/2 (DN 65) and larger.
3. Hot-Water Circulation Piping, Balancing Duty: Memory-stop balancing valves.
4. Drain Duty: Hose-end drain valves.

B. Use check valves to maintain correct direction of domestic water flow to and from equipment.

C. Iron grooved-end valves may be used with grooved-end piping.

END OF SECTION 22 1116

SECTION 22 1119
DOMESTIC WATER PIPING SPECIALTIES

PART 1 - GENERAL

1.01 SUMMARY

A. This Section includes the following domestic water piping specialties:

1. Vacuum breakers.
2. Backflow preventers.
3. Water pressure-reducing valves.
4. Balancing valves.
5. Temperature-actuated water mixing valves.
6. Strainers.
7. Hose bibbs.
8. Wall hydrants.
9. Drain valves.
10. Water hammer arresters.
11. Trap-seal primer valves.

B. Related Sections include the following:

1. Division 22 Section "Meters and Gages for Plumbing Piping" for thermometers, pressure gages, and flow meters in domestic water piping.
2. Division 22 Section "Domestic Water Piping" for water meters.
3. Division 22 Section "Domestic Water Filtration Equipment" for water filters in domestic water piping.
4. Division 22 Section "Drinking Fountains and Water Coolers" for water filters for water coolers.

1.02 PERFORMANCE REQUIREMENTS

A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig (860 kPa), unless otherwise indicated.

1.03 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Field quality-control test reports.

C. Operation and maintenance data.

1.04 QUALITY ASSURANCE

A. NSF Compliance:

1. Comply with NSF 14, "Plastics Piping Components and Related Materials," for plastic domestic water piping components.
2. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9."

PART 2 - PRODUCTS

2.01 VACUUM BREAKERS

A. Pipe-Applied, Atmospheric-Type Vacuum Breakers:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    a. Ames Co.
    b. Cash Acme.
    c. Conbraco Industries, Inc.
    d. FEBCO; SPX Valves & Controls.
    e. Rain Bird Corporation.
    f. Toro Company (The); Irrigation Div.
    g. Watts Industries, Inc.; Water Products Div.
    h. Zurn Plumbing Products Group; Wilkins Div.
3. Standard: ASSE 1001.
4. Size: NPS 1/4 to NPS 3 (DN 8 to DN 80), as required to match connected piping.
5. Body: Bronze.
6. Inlet and Outlet Connections: Threaded.
7. Finish: Chrome plated.

B. Hose-Connection Vacuum Breakers:
1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    a. Arrowhead Brass Products, Inc.
    b. Cash Acme.
    c. Conbraco Industries, Inc.
    d. Legend Valve.
    e. MIFAB, Inc.
    f. Prier Products, Inc.
    g. Watts Industries, Inc.; Water Products Div.
    h. Woodford Manufacturing Company.
    i. Zurn Plumbing Products Group; Light Commercial Operation.
    j. Zurn Plumbing Products Group; Wilkins Div.
3. Standard: ASSE 1001.
4. Body: Bronze, nonremovable, with manual drain.
5. Outlet Connection: Garden-hose threaded complying with ASME B1.20.7.
6. Finish: Chrome or nickel plated.

2.02 BACKFLOW PREVENTERS

A. Intermediate Atmospheric-Vent Backflow Preventers:
1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    a. Cash Acme.

b. Conbraco Industries, Inc.

c. FEBCO; SPX Valves & Controls.

d. Honeywell Water Controls.

e. Legend Valve.

f. Watts Industries, Inc.; Water Products Div.

g. Zurn Plumbing Products Group; Wilkins Div.

3. Standard: ASSE 1012.

4. Operation: Continuous-pressure applications.

5. Size: As noted on drawings.

6. Body: Bronze.

7. End Connections: Union, solder joint.

8. Finish: Rough bronze.

9. Domestic connection to be 'upstream' from fire protection system's fire department connection, control valves/check valves; etc. (See NFPA 13, Annex B.1)

   Domestic System's potential draw on the pressure/flow available to the fire protection system shall be applied to the fire protection system's hydraulic calculations.

B. Reduced-Pressure-Principle Backflow Preventers:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

3. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:

   a. Ames Co.

   b. Conbraco Industries, Inc.

   c. FEBCO; SPX Valves & Controls.

   d. Flomatic Corporation.

   e. Watts Industries, Inc.; Water Products Div.

   f. Zurn Plumbing Products Group; Wilkins Div.

4. Standard: ASSE 1013.

5. Operation: Continuous-pressure applications.

6. Pressure Loss: 12 psig (83 kPa) maximum, through middle 1/3 of flow range.

7. Size: As noted on drawings.

8. Design Flow Rate: As noted on drawings.

9. Body: Bronze for NPS 2 (DN 50) and smaller; cast iron with interior lining complying with AWWA C550 or that is FDA approved for NPS 2-1/2 (DN 65) and larger.

10. End Connections: Threaded for NPS 2 (DN 50) and smaller; flanged for NPS 2-1/2 (DN 65) and larger.

11. Configuration: Designed for horizontal, straight through flow.

12. Accessories:

    a. Valves: Ball type with threaded ends on inlet and outlet ofNPS 2 (DN 50) and smaller; outside screw and yoke gate-type with flanged ends on inlet and outlet of NPS 2-1/2 (DN 65) and larger.

b. Air-Gap Fitting: ASME A112.1.2, matching backflow-preventer connection.

C. Double-Check Backflow-Prevention Assemblies:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
3. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
   a. Ames Co.
   b. Conbraco Industries, Inc.
   c. FEBCO; SPX Valves & Controls.
   d. Flomatic Corporation.
   e. Watts Industries, Inc.; Water Products Div.
   f. Zurn Plumbing Products Group; Wilkins Div.
4. Standard: ASSE 1015.
5. Operation: Continuous-pressure applications, unless otherwise indicated.
6. Pressure Loss: 5 psig (35 kPa) maximum, through middle 1/3 of flow range.
7. Size: As noted on drawings.
8. Design Flow Rate: As noted on drawings.
9. Body: Bronze for NPS 2 (DN 50) and smaller; cast iron with interior lining complying with AWWA C550 or that is FDA approved for NPS 2-1/2 (DN 65) and larger.
10. End Connections: Threaded for NPS 2 (DN 50) and smaller; flanged for NPS 2-1/2 (DN 65) and larger.
11. Configuration: Designed for horizontal, straight through flow.
12. Accessories:
    a. Valves: Ball type with threaded ends on inlet and outlet of NPS 2 (DN 50) and smaller; outside screw and yoke gate-type with flanged ends on inlet and outlet of NPS 2-1/2 (DN 65) and larger.

2.03 WATER PRESSURE-REDUCING VALVES

A. Water Regulators:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Cash Acme.
   b. Conbraco Industries, Inc.
   c. Honeywell Water Controls.
   d. Watts Industries, Inc.; Water Products Div.
   e. Zurn Plumbing Products Group; Wilkins Div.
3. Standard: ASSE 1003.
4. Pressure Rating: Initial working pressure of 150 psig (1035 kPa).
5. Size: As noted on drawings.

6. Design Flow Rate: As noted on drawings.
7. Design Inlet Pressure: As noted on drawings.
8. Design Outlet Pressure Setting: As noted on drawings.
9. Body: Bronze for NPS 2 (DN 50) and smaller; cast iron with interior lining complying with AWWA C550 or that is FDA approved for NPS 2-1/2 and NPS 3 (DN 65 and DN 80).
10. End Connections: Threaded for NPS 2 (DN 50) and smaller; flanged for NPS 2-1/2 and NPS 3 (DN 65 and DN 80).

2.04 BALANCING VALVES

A. Memory-Stop Balancing Valves:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    a. Conbraco Industries, Inc.
    b. Crane Co.; Crane Valve Group; Crane Valves.
    c. Crane Co.; Crane Valve Group; Jenkins Valves.
    d. Crane Co.; Crane Valve Group; Stockham Div.
    e. Hammond Valve.
    f. Milwaukee Valve Company.
    g. NIBCO INC.
    h. Red-White Valve Corp.
3. Standard: MSS SP-110 for two-piece, copper-alloy ball valves.
4. Pressure Rating: 400-psig (2760-kPa) minimum CWP.
5. Size: NPS 2 (DN 50) or smaller.
6. Body: Copper alloy.
7. Port: Standard or full port.
8. Ball: Chrome-plated brass.
9. Seats and Seals: Replaceable.
10. End Connections: Solder joint or threaded.
11. Handle: Vinyl-covered steel with memory-setting device.

2.05 TEMPERATURE-ACTUATED WATER MIXING VALVES

A. Primary, Thermostatic, Water Mixing Valves:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
3. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
    a. Armstrong International, Inc.
    b. Lawler Manufacturing Company, Inc.
    c. Leonard Valve Company.
    d. Powers; a Watts Industries Co.

e. Symmons Industries, Inc.

4. Standard: ASSE 1017.
5. Pressure Rating: 125 psig (860 kPa).
6. Type: Exposed-mounting, thermostatically controlled water mixing valve.
7. Material: Bronze body with corrosion-resistant interior components.
8. Connections: Threaded union inlets and outlet.
9. Accessories: Manual temperature control, check stops on hot- and cold-water supplies, and adjustable, temperature-control handle.
10. Valve Pressure Rating: 125 psig (860 kPa) minimum, unless otherwise indicated.
11. Tempered-Water Setting: 105 deg F (41deg C).
12. Tempered-Water Design Flow Rate: As noted on drawings.
13. Selected Valve Flow Rate at As noted on drawings.
14. Valve Finish: Chrome plated.
15. Piping Finish: Chrome plated.
16. Cabinet: Factory-fabricated, stainless steel, for surface mounting and with hinged, stainless-steel door.

2.06 STRAINERS FOR DOMESTIC WATER PIPING

A. Y-Pattern Strainers:

1. Pressure Rating: 125 psig (860 kPa) minimum, unless otherwise indicated.
2. Body: Bronze for NPS 2 (DN 50) and smaller; cast iron with interior lining complying with AWWA C550 or FDA-approved, epoxy coating and for NPS 2-1/2 (DN 65) and larger.
3. End Connections: Threaded for NPS 2 (DN 50) and smaller; flanged for NPS 2-1/2 (DN 65) and larger.
4. Screen: Stainless steel with round perforations, unless otherwise indicated.
5. Perforation Size:
   a. Strainers NPS 2 (DN 50) and Smaller: 0.020 inch (0.51 mm).
   b. Strainers NPS 2-1/2 to NPS 4 (DN 65 to DN 100): 0.045 inch (1.14 mm).
6. Drain: Factory-installed, hose-end drain valve.

2.07 HOSE BIBBS

A. Hose Bibbs:

1. Standard: ASME A112.18.1 for sediment faucets.
2. Body Material: Bronze.
3. Seat: Bronze, replaceable.
4. Supply Connections: NPS 1/2 or NPS 3/4 (DN 15 or DN 20) threaded or solder-joint inlet.
5. Outlet Connection: Garden-hose thread complying with ASME B1.20.7.
6. Pressure Rating: 125 psig (860 kPa).
7. Vacuum Breaker: Integral or field-installation, nonremovable, drainable, hose-connection vacuum breaker complying with ASSE 1011.
8. Finish for Equipment Rooms: Rough bronze, or chrome or nickel plated.
9. Finish for Service Areas: Rough bronze.
10. Finish for Finished Rooms: Chrome or nickel plated.
11. Operation for Equipment Rooms: Wheel handle or operating key.

12. Operation for Service Areas: Wheel handle.
13. Operation for Finished Rooms: Operating key.
14. Include operating key with each operating-key hose bibb.
15. Include integral wall flange with each chrome- or nickel-plated hose bibb.

2.08 WALL HYDRANTS

A. Nonfreeze Wall Hydrants:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    a. Josam Company.
    b. MIFAB, Inc.
    c. Prier Products, Inc.
    d. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
    e. Tyler Pipe; Wade Div.
    f. Watts Drainage Products Inc.
    g. Woodford Manufacturing Company.
    h. Zurn Plumbing Products Group; Light Commercial Operation.
    i. Zurn Plumbing Products Group; Specification Drainage Operation.
3. Standard: ASME A112.21.3M for exposed-outlet, self-draining wall hydrants.
4. Pressure Rating: 125 psig (860 kPa).
5. Operation: Loose key.
6. Casing and Operating Rod: Of length required to match wall thickness. Include wall clamp.
7. Inlet: NPS 3/4 or NPS 1 (DN 20 or DN 25).
8. Outlet: Concealed, with integral vacuum breaker and garden-hose thread complying with ASME B1.20.7.
9. Box: Deep, flush mounting with cover.
10. Box and Cover Finish: Polished nickel bronze.
11. Outlet: Exposed, with integral vacuum breaker and garden-hose thread complying with ASME B1.20.7.
12. Nozzle and Wall-Plate Finish: Polished nickel bronze.
13. Operating Keys(s): One with each wall hydrant.

B. Vacuum Breaker Wall Hydrants:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    a. Arrowhead Brass Products, Inc.
    b. Mansfield Plumbing Products LLC.
    c. McDonald, A. Y. Mfg. Co.
    d. Prier Products, Inc.

e. Smith, Jay. R. Mfg. Co.; Division of Smith Industries, Inc.

f. Watts Industries, Inc.; Water Products Div.

g. Woodford Manufacturing Company.

h. Zurn Plumbing Products Group; Light Commercial Operation.

3. Standard: ASSE 1019, Type A or Type B.

4. Type: Freeze-resistant, automatic draining with integral air-inlet valve.

5. Classification: Type B, for automatic draining with hose removed or with hose attached and nozzle closed.

6. Pressure Rating: 125 psig (860 kPa).

7. Operation: Loose key.

8. Casing and Operating Rod: Of length required to match wall thickness. Include wall clamp.

9. Inlet: NPS 1/2 or NPS 3/4 (DN 15 or DN 20).

10. Outlet: Exposed with garden-hose thread complying with ASME B1.20.7.

2.09 DRAIN VALVES

A. Ball-Valve-Type, Hose-End Drain Valves:

1. Standard: MSS SP-110 for standard-port, two-piece ball valves.

2. Pressure Rating: 400-psig (2760-kPa) minimum CWP.

3. Size: NPS 3/4 (DN 20).

4. Body: Copper alloy.

5. Ball: Chrome-plated brass.

6. Seats and Seals: Replaceable.

7. Handle: Vinyl-covered steel.

8. Inlet: Threaded or solder joint.

9. Outlet: Threaded, short nipple with garden-hose thread complying with ASME B1.20.7 and cap with brass chain.

2.010 WATER HAMMER ARRESTERS

A. Water Hammer Arresters:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. AMTROL, Inc.

b. Josam Company.

c. MIFAB, Inc.

d. PPP Inc.

e. Sioux Chief Manufacturing Company, Inc.

f. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.

g. Tyler Pipe; Wade Div.

h. Watts Drainage Products Inc.

i. Zurn Plumbing Products Group; Specification Drainage Operation.

j.

3. Standard: ASSE 1010 or PDI-WH 201.
4. Type: Copper tube with piston.
5. Size: ASSE 1010, Sizes AA and A through F or PDI-WH 201, Sizes A through F.

2.011 TRAP-SEAL PRIMER VALVES

A. Supply-Type, Trap-Seal Primer Valves:
1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. MIFAB, Inc.
b. PPP Inc.
c. Sioux Chief Manufacturing Company, Inc.
d. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
e. Watts Industries, Inc.; Water Products Div.
3. Standard: ASSE 1018.
4. Pressure Rating: 125 psig (860 kPa) minimum.
5. Body: Bronze.
6. Inlet and Outlet Connections: NPS 1/2 (DN 15) threaded, union, or solder joint.
7. Gravity Drain Outlet Connection: NPS 1/2 (DN 15) threaded or solder joint.
8. Finish: Chrome plated, or rough bronze for units used with pipe or tube that is not chrome finished.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Refer to Division 22 Section "Common Work Results for Plumbing" for piping joining materials, joint construction, and basic installation requirements.

B. Install backflow preventers in each water supply to mechanical equipment and systems and to other equipment and water systems that may be sources of contamination. Comply with authorities having jurisdiction.
1. Locate backflow preventers in same room as connected equipment or system.
2. Install drain for backflow preventers with atmospheric-vent drain connection with air-gap fitting, fixed air-gap fitting, or equivalent positive pipe separation of at least two pipe diameters in drain piping and pipe to floor drain. Locate air-gap device attached to or under backflow preventer. Simple air breaks are not acceptable for this application.
3. Do not install bypass piping around backflow preventers.

C. Install water regulators with inlet and outlet shutoff valves and bypass with memory-stop balancing valve. Install pressure gages on inlet and outlet.

D. Install balancing valves in locations where they can easily be adjusted.

E. Install temperature-actuated water mixing valves with check stops or shutoff valves on inlets and with shutoff valve on outlet.
1. Install thermometers and water regulators if specified.
2. Install cabinet-type units recessed in or surface mounted on wall as specified.

F. Install Y-pattern strainers for water on supply side of each water pressure-reducing valve.

G. Install water hammer arresters in water piping according to PDI-WH 201.

H. Install supply-type, trap-seal primer valves with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting. Adjust valve for proper flow.

I. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping and specialties.

J. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:

1. Intermediate atmospheric-vent backflow preventers.
2. Reduced-pressure-principle backflow preventers.
3. Double-check backflow-prevention assemblies.
4. Water pressure-reducing valves.
5. Primary, thermostatic, water mixing valves.
6. Supply-type, trap-seal primer valves.

K. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Division 22 Section "Identification for Plumbing Piping and Equipment."

3.02 FIELD QUALITY CONTROL

A. Perform the following tests and prepare test reports:

1. Test each reduced-pressure-principle backflow preventer and double-check backflow-prevention assembly according to authorities having jurisdiction and the device's reference standard.

B. Remove and replace malfunctioning domestic water piping specialties and retest as specified above.

3.03 ADJUSTING

A. Set field-adjustable pressure set points of water pressure-reducing valves.

B. Set field-adjustable flow of balancing valves.

C. Set field-adjustable temperature set points of temperature-actuated water mixing valves.

END OF SECTION 22 1119

SECTION 22 1316
SANITARY WASTE AND VENT PIPING

PART 1 - GENERAL

1.01 SUMMARY

A. This Section includes the following soil and waste, sanitary drainage and vent piping inside the building:

1. Pipe, tube, and fittings.
2. Special pipe fittings.

1.02 PERFORMANCE REQUIREMENTS

A. Components and installation shall be capable of withstanding the following minimum working pressure, unless otherwise indicated:

1. Soil, Waste, and Vent Piping: 10-foot head of water (30 kPa).

1.03 SUBMITTALS

A. Product Data: For pipe, tube, fittings, and couplings.

B. Field quality-control inspection and test reports.

1.04 QUALITY ASSURANCE

A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

B. Comply with NSF 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with "NSF-dwv" for plastic drain, waste, and vent piping; and "NSF-drain" for plastic drain piping.

PART 2 - PRODUCTS

2.01 PIPING MATERIALS

A. Hub-and-Spigot, Cast-Iron Pipe and Fittings: ASTM A 74, Service class.

1. Gaskets: ASTM C 564, rubber.

B. Hubless Cast-Iron Pipe and Fittings: ASTM A 888 or CISPI 301.

1. Sovent Stack Fittings: ASME B16.45 or ASSE 1043, hubless, cast-iron aerator and deaerator drainage fittings.
2. Shielded Couplings: ASTM C 1277 assembly of metal shield or housing, corrosion-resistant fasteners, and rubber sleeve with integral, center pipe stop.
    a. Standard, Shielded, Stainless-Steel Couplings: CISPI 310, with stainless-steel corrugated shield; stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve.
    b. Heavy-Duty, Shielded, Stainless-Steel Couplings: With stainless-steel shield, stainless-steel bands and tightening devices, and ASTM C 564, rubber sleeve.

C. Steel Pipe: ASTM A 53/A 53M, Type E or S, Grade A or B, Schedule 40, galvanized. Include ends matching joining method.

1. Drainage Fittings: ASME B16.12, threaded, cast-iron drainage pattern.
2. Pressure Fittings:
    a. Steel Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M or ASTM A 106, Schedule 40, galvanized, seamless steel pipe. Include ends matching joining method.
    b. Malleable-Iron Unions: ASME B16.39; Class 150; hexagonal-stock body with ball-and-socket, metal-to-metal, bronze seating surface; and female threaded ends.
    c. Gray-Iron, Threaded Fittings: ASME B16.4, Class 125, standard pattern.
    d. Cast-Iron Flanges: ASME B16.1, Class 125.

e. Cast-Iron, Flanged Fittings: ASME B16.1, Class 125.

D. Copper DWV Tube: ASTM B 306, drainage tube, drawn temper.

1. Copper Drainage Fittings: ASME B16.23, cast copper or ASME B16.29, wrought-copper, solder-joint fittings.

E. Solid-Wall ABS Pipe: ASTM D 2661, Schedule 40, solid wall.

1. ABS Socket Fittings: ASTM D 2661, made to ASTM D 3311, drain, waste, and vent patterns.

2. Solvent Cement and Adhesive Primer:

a. Use ABS solvent cement that has a VOC content of 325 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

b. Use adhesive primer that has a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

F. Solid-Wall PVC Pipe: ASTM D 2665, solid-wall drain, waste, and vent.

1. PVC Socket Fittings: ASTM D 2665, socket type, made to ASTM D 3311, drain, waste, and vent patterns.

2. Solvent Cement and Adhesive Primer:

a. Use PVC solvent cement that has a VOC content of 510 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

b. Use adhesive primer that has a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

PART 3 - EXECUTION

3.01 PIPING APPLICATIONS

A. Special pipe fittings with pressure ratings at least equal to piping pressure ratings may be used in applications below, unless otherwise indicated.

B. Flanges and unions may be used on aboveground pressure piping, unless otherwise indicated.

C. Aboveground, soil, waste, and vent piping NPS 4 (DN 100) and smaller shall be any of the following:

1. Service class, hub-and-spigot, cast-iron soil pipe and fittings; gaskets; and compression joints.

2. Hubless cast-iron soil pipe and fittings and sovent stack fittings; standard, shielded, stainless-steel couplings; and hubless-coupling joints.

3. Steel pipe, drainage fittings, and threaded joints.

4. Copper DWV tube, copper drainage fittings, and soldered joints.

D. Aboveground, soil, waste, and vent piping NPS 5 (DN 125) and larger shall beany of the following:

1. Service class, cast-iron soil pipe and fittings; gaskets; and compression joints.

2. Hubless cast-iron soil pipe and fittings and sovent stack fittings; standard, shielded, stainless-steel couplings; and hubless-coupling joints.

E. Underground, soil, waste, and vent piping NPS 4 (DN 100) and smaller shall be any of the following:

1. Service class, hub-and-spigot, cast-iron soil pipe and fittings; gaskets; and compression joints.

2. Hubless cast-iron soil pipe and fittings; standard, shielded, stainless-steel couplings; and hubless-coupling joints.

3. Solid-wall ABS pipe, ABS socket fittings, and solvent-cemented joints.

4. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.

F. Underground, soil and waste Piping NPS 5 (DN 125) and larger shall be any of the following:

1. Service class, cast-iron soil pipe and fittings; gaskets; and compression joints.
2. Hubless cast-iron soil pipe and fittings; heavy-duty, shielded, stainless-steel couplings; and hubless-coupling joints.
3. ABS pipe, ABS socket fittings, and solvent-cemented joints.
4. Solid-wall ABS pipe, ABS socket fittings, and solvent-cemented joints.
5. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.

3.02 PIPING INSTALLATION

A. Sanitary sewer piping outside the building is specified in Division 22 Section "Facility Sanitary Sewers."

B. Basic piping installation requirements are specified in Division 22 Section "Common Work Results for Plumbing."

C. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers.

D. Install cast-iron sleeve with water stop and mechanical sleeve seal at each service pipe penetration through foundation wall. Select number of interlocking rubber links required to make installation watertight. Sleeves and mechanical sleeve seals are specified in Division 22 Section "Common Work Results for Plumbing."

E. Install wall penetration system at each service pipe penetration through foundation wall. Make installation watertight. Wall penetration systems are specified in Division 22 Section "Common Work Results for Plumbing."

F. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."

G. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical. Use long-turn, double Y-branch and 1/8-bend fittings if 2 fixtures are installed back to back or side by side with common drain pipe. Straight tees, elbows, and crosses may be used on vent lines. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.

H. Lay buried building drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.

I. Install soil and waste drainage and vent piping at the following minimum slopes, unless otherwise indicated:

1. Building Sanitary Drain: 2 percent downward in direction of flow for piping NPS 3 (DN 80) and smaller; 1 percent downward in direction of flow for piping NPS 4 (DN 100) and larger.
2. Horizontal Sanitary Drainage Piping: 2 percent downward in direction of flow.
3. Vent Piping: 1 percent down toward vertical fixture vent or toward vent stack.

J. Sleeves are not required for cast-iron soil piping passing through concrete slabs-on-grade if slab is without membrane waterproofing.

K. Install ABS soil and waste drainage and vent piping according to ASTM D 2661.

L. Install PVC soil and waste drainage and vent piping according to ASTM D 2665.

M. Install underground ABS and PVC soil and waste drainage piping according to ASTM D 2321.

N. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

3.03 JOINT CONSTRUCTION

A. Basic piping joint construction requirements are specified in Division 22 Section "Common Work Results for Plumbing."

B. Cast-Iron, Soil-Piping Joints: Make joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."

1. Gasketed Joints: Make with rubber gasket matching class of pipe and fittings.
2. Hubless Joints: Make with rubber gasket and sleeve or clamp.

C. Soldered Joints: Use ASTM B 813, water-flushable, lead-free flux; ASTM B 32, lead-free-alloy solder; and ASTM B 828 procedure, unless otherwise indicated.

D. PVC Nonpressure Piping Joints: Join piping according to ASTM D 2665.

3.04 VALVE INSTALLATION

A. General-duty valves are specified in Division 22 Section "General-Duty Valves for Plumbing Piping."

B. Shutoff Valves: Install shutoff valve on each sewage pump discharge.

1. Use gate or full-port ball valve for piping NPS 2 (DN 50) and smaller.
2. Use gate valve for piping NPS 2-1/2 (DN 65) and larger.

C. Check Valves: Install swing check valve, downstream from shutoff valve, on each sewage pump discharge.

D. Backwater Valves: Install backwater valves in piping subject to sewage backflow.

1. Horizontal Piping: Horizontal backwater valves. Use normally closed type, unless otherwise indicated.
2. Floor Drains: Drain outlet backwater valves, unless drain has integral backwater valve.
3. Install backwater valves in accessible locations.
4. Backwater valves are specified in Division 22 Section "Sanitary Waste Piping Specialties."

3.05 HANGER AND SUPPORT INSTALLATION

A. Seismic-restraint devices are specified in Division 22 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment."

B. Pipe hangers and supports are specified in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment." Install the following:

1. Vertical Piping: MSS Type 8 or Type 42, clamps.
2. Individual, Straight, Horizontal Piping Runs: According to the following:
    a. 100 Feet (30 m) and Less: MSS Type 1, adjustable, steel clevis hangers.
    b. Longer Than 100 Feet (30 m): MSS Type 43, adjustable roller hangers.
    c. Longer Than 100 Feet (30 m), if Indicated: MSS Type 49, spring cushion rolls.
3. Multiple, Straight, Horizontal Piping Runs 100 Feet (30 m) or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
4. Base of Vertical Piping: MSS Type 52, spring hangers.

C. Install supports according to Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment."

D. Support vertical piping and tubing at base and at each floor.

E. Rod diameter may be reduced 1 size for double-rod hangers, with 3/8-inch (10-mm) minimum rods.

F. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/2 and NPS 2 (DN 40 and DN 50): 60 inches (1500 mm) with 3/8-inch (10-mm) rod.
2. NPS 3 (DN 80): 60 inches (1500 mm) with 1/2-inch (13-mm) rod.
3. NPS 4 and NPS 5 (DN 100 and DN 125): 60 inches (1500 mm) with 5/8-inch (16-mm) rod.
4. NPS 6 (DN 150): 60 inches (1500 mm) with 3/4-inch (19-mm) rod.
5. Spacing for 10-foot (3-m) lengths may be increased to 10 feet (3 m). Spacing for fittings is limited to 60 inches (1500 mm).

G. Install supports for vertical cast-iron soil piping every 15 feet (4.5 m).

H. Install hangers for steel piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/4 (DN 32): 84 inches (2100 mm) with 3/8-inch (10-mm) rod.
2. NPS 1-1/2 (DN 40): 108 inches (2700 mm) with 3/8-inch (10-mm) rod.
3. NPS 2 (DN 50): 10 feet (3 m) with 3/8-inch (10-mm) rod.
4. NPS 2-1/2 (DN 65): 11 feet (3.4 m) with 1/2-inch (13-mm) rod.
5. NPS 3 (DN 80): 12 feet (3.7 m) with 1/2-inch (13-mm) rod.
6. NPS 4 and NPS 5 (DN 100 and DN 125): 12 feet (3.7 m) with 5/8-inch (16-mm) rod.
7. NPS 6 (DN 150): 12 feet (3.7 m) with 3/4-inch (19-mm) rod.

I. Install supports for vertical steel piping every 15 feet (4.5 m).

J. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/4 (DN 32): 72 inches (1800 mm) with 3/8-inch (10-mm) rod.
2. NPS 1-1/2 and NPS 2 (DN 40 and DN 50): 96 inches (2400 mm) with 3/8-inch (10-mm) rod.
3. NPS 2-1/2 (DN 65): 108 inches (2700 mm) with 1/2-inch (13-mm) rod.
4. NPS 3 to NPS 5 (DN 80 to DN 125): 10 feet (3 m) with 1/2-inch (13-mm) rod.
5. NPS 6 (DN 150): 10 feet (3 m) with 5/8-inch (16-mm) rod.

K. Install supports for vertical copper tubing every 10 feet (3 m).

L. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.06 CONNECTIONS

A. Connect soil and waste piping to exterior sanitary sewerage piping. Use transition fitting to join dissimilar piping materials.

B. Connect drainage and vent piping to the following:

1. Plumbing Fixtures and Equipment: Connect atmospheric vent piping in sizes indicated, but not smaller than required by authorities having jurisdiction.

3.07 FIELD QUALITY CONTROL

A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.

1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.

B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.

C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

D. Test sanitary drainage and vent piping according to procedures of authorities having jurisdiction.

1. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.

2. Prepare reports for tests and required corrective action.

3.08 CLEANING

A. Clean interior of piping. Remove dirt and debris as work progresses.

B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.

C. Place plugs in ends of uncompleted piping at end of day and when work stops.

END OF SECTION 22 1316

SECTION 22 1319

SANITARY WASTE PIPING SPECIALTIES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. This Section includes the following sanitary drainage piping specialties:

1. Backwater valves.
2. Cleanouts.
3. Floor drains.
4. Roof flashing assemblies.
5. Through-penetration firestop assemblies.
6. Miscellaneous sanitary drainage piping specialties.
7. Flashing materials.
8. Grease interceptors.
9. Sand/oil interceptors.

B. Related Sections include the following:

1. Division 22 Section "Sanitary Sewerage Pumps for applications in site-construction sewage pumping.

1.03 DEFINITIONS

A. ABS: Acrylonitrile-butadiene-styrene plastic.

B. FOG: Fats, oils, and greases.

C. FRP: Fiberglass-reinforced plastic.

D. HDPE: High-density polyethylene plastic.

E. PE: Polyethylene plastic.

F. PP: Polypropylene plastic.

G. PVC: Polyvinyl chloride plastic.

1.04 SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and accessories for the following:

1. FOG disposal systems.
2. Grease interceptors.
3. Grease removal devices.
4. Sand/Oil interceptors.

B. Shop Drawings: Show fabrication and installation details for frost-resistant vent terminals.

1. Wiring Diagrams: Power, signal, and control wiring.

C. Field quality-control test reports.

D. Operation and Maintenance Data: For drainage piping specialties to include in emergency, operation, and maintenance manuals.

1.05 QUALITY ASSURANCE

A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with NSF 14, "Plastics Piping Components and Related Materials," for plastic sanitary piping specialty components.

1.06 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

B. Coordinate size and location of roof penetrations.

PART 2 - PRODUCTS

2.01 BACKWATER VALVES

A. Horizontal, Cast-Iron Backwater Valves:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
3. Basis-of-Design Product: Subject to compliance with requirements, a comparable product by one of the following:
    a. Josam Company; Josam Div.
    b. MIFAB, Inc.
    c. Smith, Jay R. Mfr. Co.; Division of Smith Industries, Inc.
    d. Tyler Pipe; Wade Div.
    e. Watts Drainage Products Inc.
    f. Zurn Plumbing Products Group; Specification Drainage Operation.
4. Standard: ASME A112.14.1.
5. Size: Same as connected piping.
6. Body: Cast iron.
7. Cover: Cast iron with bolted access check valve.
8. End Connections: Hub and spigot.
9. Extension: ASTM A 74, Service class; full-size, cast-iron, soil-pipe extension to field-installed cleanout at floor; replaces backwater valve cover.

2.02 CLEANOUTS

A. Exposed Metal Cleanouts

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
3. Basis-of-Design Product: Subject to compliance with requirements, comparable product by one of the following:
    a. Josam Company; Josam Div.
    b. MIFAB, Inc.
    c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
    d. Tyler Pipe; Wade Div.

e. Watts Drainage Products Inc.

f. Zurn Plumbing Products Group; Specification Drainage Operation.

g. Josam Company; Blucher-Josam Div.

4. Standard: ASME A112.36.2M for cast iron for cleanout test tee.

5. Size: Same as connected drainage piping

6. Body Material: Hub-and-spigot, cast-iron soil pipe T-branch as required to match connected piping.

7. Closure: Countersunk.

8. Closure Plug Size: Same as or not more than one size smaller than cleanout size.

9. Closure: Stainless-steel plug with seal.

B. Metal Floor Cleanouts :

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

3. Basis-of-Design Product: Comparable product by one of the following:

a. Josam Company; Josam Div.

b. Oatey.

c. Sioux Chief Manufacturing Company, Inc.

d. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.

e. Tyler Pipe; Wade Div.

f. Watts Drainage Products Inc.

g. Zurn Plumbing Products Group; Light Commercial Operation.

h. Zurn Plumbing Products Group; Specification Drainage Operation.

i. Kusel Equipment Co.

j. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.

k. Josam Company; Blucher-Josam Div.

4. Standard: ASME A112.36.2M for **adjustable housing** cleanout.

5. Size: Same as connected branch.

C. Cast-Iron Wall Cleanouts:

1. Basis-of-Design Product: Compliance comparable product by one of the following:

a. Josam Company; Josam Div.

b. MIFAB, Inc.

c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.

d. Tyler Pipe; Wade Div.

e. Watts Drainage Products Inc.

f. Zurn Plumbing Products Group; Specification Drainage Operation.

2. Standard: ASME A112.36.2M. Include wall access.

3. Size: Same as connected drainage piping.

4. Body: Hub-and-spigot, cast-iron soil pipe T-branch as required to match connected piping.

2.03 FLOOR DRAINS

A. Cast-Iron Floor Drains :

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings**.** Materials: As recommended by system manufacturer.

2.04 THROUGH-PENETRATION FIRESTOP ASSEMBLIES

A. Through-Penetration Firestop Assemblies:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. ProSet Systems Inc.

3. Standard: UL 1479 assembly of sleeve and stack fitting with firestopping plug.
4. Size: Same as connected soil, waste, or vent stack.
5. Sleeve: Molded PVC plastic, of length to match slab thickness and with integral nailing flange on one end for installation in cast-in-place concrete slabs.
6. Stack Fitting: ASTM A 48/A 48M, gray-iron, hubless-pattern, wye branch with neoprene O-ring at base and gray-iron plug in thermal-release harness. Include PVC protective cap for plug.
7. Special Coating: Corrosion resistant on interior of fittings.

2.05 FLASHING MATERIALS

A. Lead Sheet: ASTM B 749, Type L51121, copper bearing, with the following minimum weights and thicknesses, unless otherwise indicated:

1. General Use: 4.0-lb/sq. ft. 0.0625-inch thickkness.
2. Vent Pipe Flashing: 3.0-lb/sq. ft., 0.0469-inch thickness.
3. Burning: 6-lb/sq. ft., 0.0938-inch thickness.

B. Copper Sheet: ASTM B 152/B 152M, of the following minimum weights and thicknesses, unless otherwise indicated:

1. General Applications: 12 oz./sq. ft.
2. Vent Pipe Flashing: 8 oz./sq. ft.

C. Zinc-Coated Steel Sheet: ASTM A 653/A 653M, with 0.20 percent copper content and 0.04-inch minimum thickness, unless otherwise indicated. Include G90 hot-dip galvanized, mill-phosphatized finish for painting if indicated.

D. Elastic Membrane Sheet: ASTM D 4068, flexible, chlorinated polyethylene, 40-mil minimum thickness.

E. Fasteners: Metal compatible with material and substrate being fastened.

F. Metal Accessories: Sheet metal strips, clamps, anchoring devices, and similar accessory units required for installation; matching or compatible with material being installed.

G. Solder: ASTM B 32, lead-free alloy.

2.06 INTERCEPTORS

2.07 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.
2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.08 GREASE INTERCEPTORS

A. Grease Interceptors: Cast-in-place-concrete or precast concrete structure complying with requirements of ASTM c33/PDI

B. Grease Interceptors: Construct bottom, sidewalls, and top of reinforced, cast-in-place concrete. Include manholes, compartments or baffles, and piping or openings to retain grease and to permit wastewater flow.

1. Concrete: Comply with ACI 318/318R, ACI 350R.
    a. Design Mix: 4000 psig minimum, with 0.45 maximum water-to-cementitious materials ratio.
    b. Portland Cement: ASTM C 150, Type II.
    c. Fine Aggregate: ASTM C 33, sand.
    d. Coarse Aggregate: ASTM C 33, crushed gravel.
    e. Water: Potable.
    f. Reinforcing Fabric: ASTM A 185, steel, welded wire fabric, plain.
    g. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 deformed steel.

C. Grease Interceptors: Precast concrete complying with ASTM C 913. Include rubber-gasketed joints, manholes, compartments or baffles, and piping or openings to retain grease and to permit wastewater flow.

1. Protective Coating: Plant-applied, coal-tar 10-mil (0.26-mm) minimum thickness applied to all exterior and interior concrete surfaces.
2. Structural Design Loads:
    a. Light-Traffic Load: Comply with ASTM C 890, A-8 (ASSHTO HS10- 44).
    b. Medium-Traffic Load: Comply with ASTM C 890, A-12 (ASSHTO HS15-44).
    c. Heavy-Traffic Load: Comply with ASTM C 890, A-16 (ASSHTO HS20-44).
    d. Walkway Load: Comply with ASTM C 890, A-03.
3. Resilient Pipe Connectors: ASTM C 923 (ASTM C 923M), cast or fitted into interceptor walls, for each pipe connection.
4. Steps: Individual FRP steps, FRP ladder, or ASTM A 615/A 615M, deformed, 1/2-inch (13-mm) steel reinforcing rods encased in ASTM D 4101, PP, wide enough to allow worker to place both feet on 1 step and designed to prevent lateral slippage off of step. Cast or anchor steps into sidewalls at 12- to 16-inch (300- to 400-mm) intervals. Omit steps if total depth from floor of interceptor to finished grade is less than 48 inches.
5. Grade Rings: Reinforced-concrete rings, 6- to 9-inch (150- to 225-mm) total thickness, to match diameter of manhole frame and cover.
6. Manhole Frames and Covers: Ferrous; 24-inch (610-mm) ID by 7- to 9-inch (175- to 225-mm) riser with 4-inch- (100-mm-) minimum width flange and 26-inch- (660-mm-) diameter cover.
    a. Ductile Iron: ASTM A 536, Grade 60-40-18, unless otherwise indicated.
    b. Gray Iron: ASTM A 48, Class 35, unless otherwise indicated.
    c. Include indented top design with lettering cast into cover, using wording equivalent to "GREASE INTERCEPTOR."

d. Protective Coating: Foundry-applied, SSPC-Paint 16 or epoxy-polyamide paint 10-mil (0.26-mm) minimum thickness applied to all ferrous surfaces.

2.09 SAND AND OIL INTERCEPTORS

A. Sand and Oil Interceptors: Cast-in-place-concrete or precast concrete structure complying with requirements of ASTM c33/PDI.

B. Sand and Oil Interceptors: Construct bottom, sidewalls, and top of reinforced, cast- in-place concrete. Include waste oil and vent connections, manholes, compartments or baffles, and piping or openings to draw off oil and to permit wastewater flow.

1. Concrete: Comply with ACI 318/318R, ACI 350R.
   a. Design Mix: 4000 psig (27.6 MPa) minimum, with 0.45 maximum water-to-cementitious materials ratio.
   b. Portland Cement: ASTM C 150, Type II.
   c. Fine Aggregate: ASTM C 33, sand.
   d. Coarse Aggregate: ASTM C 33, crushed gravel.
   e. Water: Potable.
   f. Reinforcing Fabric: ASTM A 185, steel, welded wire fabric, plain.
   g. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (420 MPa), deformed steel.

C. Sand and Oil Interceptors: Precast concrete comply with ASTM C 913. Include rubber-gasketed joints, vent connections, manholes, compartments or baffles, and piping or openings to retain grease and to permit wastewater flow.

1. Protective Coating: Plant-applied, coal-tar 10-mil (0.26-mm) minimum thickness applied to all exterior and interior concrete surfaces.
2. Structural Design Loads:
   a. Light-Traffic Load: Comply with ASTM C 890, A-8 (ASSHTO HS10- 44).
   b. Medium-Traffic Load: Comply with ASTM C 890, A-12 (ASSHTO HS15-44).
   c. Heavy-Traffic Load: Comply with ASTM C 890, A-16 (ASSHTO HS20-44).
   d. Walkway Load: Comply with ASTM C 890, A-03.
3. Resilient Pipe Connectors: ASTM C 923 (ASTM C 923M), cast or fitted into interceptor walls, for each pipe connection.
4. Steps: ASTM A 615/A 615M, deformed, 1/2-inch (13-mm) steel reinforcing rods encased in ASTM D 4101, PP, wide enough to allow worker to place both feet on 1 step and designed to prevent lateral slippage off of step. Cast or anchor steps into sidewalls at 12- to 16-inch (300- to 400-mm) intervals. Omit steps if total depth from floor of interceptor to finished grade is less than 48 inches.
5. Grade Rings: Reinforced-concrete rings, 6- to 9-inch total thickness, to match diameter of manhole frame and cover.
6. Manhole Frames and Covers: Ferrous; 24-inch (610-mm) ID by 7- to 9-inch riser with 4-inch- (100-mm-) minimum width flange and 26-inch- (660-mm-) diameter cover.
   a. Ductile Iron: ASTM A 536, Grade 60-40-18, unless otherwise indicated.
   b. Gray Iron: ASTM A 48, Class 35, unless otherwise indicated.
   c. Include indented top design with lettering cast into cover, using wording equivalent to "OIL INTERCEPTOR."
   d. Protective Coating: Foundry-applied, SSPC-Paint 16 or epoxy-polyamide paint; 10-mil (0.26-mm) minimum thickness applied to all ferrous surfaces.

PART 3 - EXECUTION

3.01 Not used

3.02 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.

B. Tests and Inspections:

1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.

2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3.03 PROTECTION

A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.

B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION 22 1319

SECTION 22 1413
FACILITY STORM DRAINAGE PIPING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. This Section includes the following storm drainage piping inside the building:

1. Pipe, tube, and fittings.
2. Special pipe fittings.
3. Encasement for underground metal piping.

B. Related Sections include the following:

1. Division 22 Section "Sump Pumps."

1.03 DEFINITIONS

A. ABS: Acrylonitrile-butadiene-styrene plastic.

B. LLDPE: Linear, low-density polyethylene plastic.

C. PE: Polyethylene plastic.

D. PVC: Polyvinyl chloride plastic.

E. TPE: Thermoplastic elastomer.

1.04 PERFORMANCE REQUIREMENTS

A. Components and installation shall be capable of withstanding the following minimum working-pressure, unless otherwise indicated:

1. Storm Drainage Piping: 10-foot head of water .
2. Storm Drainage, Force-Main Piping: 50 psig.

B. Seismic Performance: Soil, waste, and vent piping and support and installation shall be capable of withstanding the effects of seismic events determined according to ASCE 7, "Minimum Design Loads for Buildings and Other Structures."

1.05 SUBMITTALS

A. Product Data: For pipe, tube, fittings, and couplings.

B. Shop Drawings:

1. Design Calculations: Signed and sealed by a qualified professional engineer for selecting seismic restraints.
2. Controlled-Flow Storm Drainage System: Include calculations, plans, and details.

C. Field quality-control inspection and test reports.

1.06 QUALITY ASSURANCE

A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

B. Comply with NSF 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with "NSF-drain" for plastic drain piping and "NSF-sewer" for plastic sewer piping.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.
2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.02 PIPING MATERIALS

A. Refer to Part 3 "Piping Applications" Article for applications of pipe, tube, fitting, and joining materials.

2.03 HUB-AND-SPIGOT, CAST-IRON SOIL PIPE AND FITTINGS

A. Pipe and Fittings: ASTM A 74, Service class(es).

B. Gaskets: ASTM C 564, rubber.

C. Calking Materials: ASTM B 29, pure lead and oakum or hemp fiber.

2.04 HUBLESS CAST-IRON SOIL PIPE AND FITTINGS

A. Pipe and Fittings: ASTM A 888 or CISPI 301.

B. Shielded Couplings: ASTM C 1277 assembly of metal shield or housing, corrosion-resistant fasteners, and rubber sleeve with integral, center pipe stop.

1. Standard, Shielded, Stainless-Steel Couplings: CISPI 310, with stainless-steel corrugated shield; stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve.
    a. Manufacturers:
        1) ANACO.
        2) Fernco, Inc.
        3) Ideal Div.; Stant Corp.
        4) Mission Rubber Co.
        5) Tyler Pipe; Soil Pipe Div.

2. Heavy-Duty, Shielded, Stainless-Steel Couplings: With stainless-steel shield, stainless-steel bands and tightening devices, and ASTM C 564, rubber sleeve.
    a. Manufacturers:
        1) ANACO.
        2) Clamp-All Corp.
        3) Ideal Div.; Stant Corp.
        4) Mission Rubber Co.
        5) Tyler Pipe; Soil Pipe Div.
3. Heavy-Duty, Shielded, Cast-Iron Couplings: ASTM A 48/A 48M, two-piece, cast-iron housing; stainless-steel bolts and nuts; and ASTM C 564, rubber sleeve.
    a. Manufacturers:
        1) MG Piping Products Co.

C. Rigid, Unshielded Couplings: ASTM C 1461, sleeve-type, reducing- or transition-type mechanical coupling molded from ASTM C 1440, TPE material with corrosion-resistant-metal tension band and tightening mechanism on each end.

1. Manufacturers:
    a. ANACO.

2.05 STEEL PIPE AND FITTINGS

A. Steel Pipe: ASTM A 53/A 53M, Type E or S, Grade A or B, Standard Weight or Schedule 40, galvanized. Include ends matching joining method.

B. Drainage Fittings: ASME B16.12[, galvanized], threaded, cast-iron drainage pattern.

C. Pressure Fittings:

1. Steel Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M or ASTM A 106, Schedule 40, galvanized, seamless steel pipe. Include ends matching joining method.
2. Malleable-Iron Unions: ASME B16.39; Class 150; hexagonal-stock body with ball-and-socket, metal-to-metal, bronze seating surface; and female threaded ends.
3. Gray-Iron, Threaded Fittings: ASME B16.4, Class 125, galvanized, standard pattern.
4. Cast-Iron Flanges: ASME B16.1, Class 125.
5. Cast-Iron, Flanged Fittings: ASME B16.1, Class 125, galvanized.

D. Grooved-Joint Systems:

1. Manufacturers:
   a. Anvil International.
   b. Star Pipe Products; Star Fittings Div.
   c. Victaulic Co. of America.
   d. Ward Manufacturing, Inc.
2. Grooved-End, Steel-Piping Fittings: ASTM A 47/A 47M, galvanized, malleable-iron casting; ASTM A 106, galvanized-steel pipe; or ASTM A 536, galvanized, ductile-iron casting; with dimensions matching steel pipe.
3. Grooved-End, Steel-Piping Couplings: AWWA C606, for steel-pipe dimensions. Include ferrous housing sections, gasket suitable for water, and bolts and nuts.

2.06 DUCTILE-IRON PIPE AND FITTINGS

A. Mechanical-Joint, Ductile-Iron Pipe: AWWA C151, with mechanical-joint bell and plain spigot end, unless grooved or flanged ends are indicated.

1. Mechanical-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
2. Glands, Gaskets, and Bolts: AWWA C111, ductile- or gray-iron glands, rubber gaskets, and steel bolts.

B. Push-on-Joint, Ductile-Iron Pipe: AWWA C151, with push-on-joint bell and plain spigot end, unless grooved or flanged ends are indicated.

1. Push-on-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
2. Gaskets: AWWA C111, rubber.

C. Grooved-Joint Systems:

1. Manufacturers:
   a. Anvil International.
   b. Star Pipe Products; Star Fittings Div.
   c. Victaulic Co. of America.
2. Grooved-End, Ductile-Iron Fittings: ASTM A 47/A 47M, malleable-iron castings or ASTM A 536, ductile-iron castings with dimensions matching pipe.
3. Grooved-End, Ductile-Iron-Piping Couplings: AWWA C606, for ductile-iron-pipe dimensions. Include ferrous housing sections, gasket suitable for water, and bolts and nuts.

D. Flanges: ASME 16.1, Class 125, cast iron.

2.07 COPPER TUBE AND FITTINGS

A. Copper DWV Tube: ASTM B 306, drainage tube, drawn temper.

1. Copper Drainage Fittings: ASME B16.23, cast-copper or ASME B16.29, wrought-copper, solder-joint fittings.

B. Hard Copper Tube: ASTM B 88, Types L and M, 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. Copper Flanges: ASME B16.24, Class 150, cast copper with solder-joint end.
3. Copper Unions: MSS SP-123, copper-alloy, hexagonal-stock body with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.

C. Soft Copper Tube: ASTM B 88, Type L, 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.

2.08 ABS PIPE AND FITTINGS

A. Solid-Wall ABS Pipe: ASTM D 2661, Schedule 40.

B. Cellular-Core ABS Pipe: ASTM F 628, Schedule 40.

C. ABS Socket Fittings: ASTM D 2661, made to ASTM D 3311, drain, waste, and vent patterns.

D. Solvent Cement and Adhesive Primer:

1. Use ABS solvent cement that has a VOC content of 325 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Use adhesive primer that has a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.09 PVC PIPE AND FITTINGS

A. Solid-Wall PVC Pipe: ASTM D 2665, drain, waste, and vent.

B. Cellular-Core PVC Pipe: ASTM F 891, Schedule 40.

1. PVC Socket Fittings: ASTM D 2665, made to ASTM D 3311, drain, waste, and vent patterns and to fit Schedule 40 pipe.

C. Cellular-Core, Sewer and Drain Series, PVC Pipe: ASTM F 891, Series PS 100.

1. PVC Socket Fittings: ASTM D 2665, made to ASTM D 3311, drain, waste, and vent patterns and to fit Series PS 100 sewer and drain pipe.

D. Solvent Cement and Adhesive Primer:

1. Use PVC solvent cement that has a VOC content of 510 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Use adhesive primer that has a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.10 SPECIAL PIPE FITTINGS

A. Flexible, Nonpressure Pipe Couplings: Comply with ASTM C 1173, elastomeric, sleeve-type, reducing or transition pattern. Include shear ring, ends of same sizes as piping to be joined, and corrosion-resistant-metal tension band and tightening mechanism on each end.

1. Manufacturers:
    a. Dallas Specialty & Mfg. Co.
    b. Fernco, Inc.
    c. Logan Clay Products Company (The).
    d. Mission Rubber Co.

e. NDS, Inc.

f. Plastic Oddities, Inc.

2. Sleeve Materials:

a. For Cast-Iron Soil Pipes: ASTM C 564, rubber.

b. For Plastic Pipes: ASTM F 477, elastomeric seal or ASTM D 5926, PVC.

c. For Dissimilar Pipes: ASTM D 5926, PVC or other material compatible with pipe materials being joined.

B. Couplings in paragraph and subparagraphs below are for aboveground nonpressure piping and should be available in most sizes.

C. Shielded Nonpressure Pipe Couplings: ASTM C 1460, elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.

1. Manufacturers:

a. Cascade Waterworks Mfg. Co.

b. Mission Rubber Co.

c. NDS, Inc.

D. Rigid, Unshielded, Nonpressure Pipe Couplings: ASTM C 1461, sleeve-type reducing- or transition-type mechanical coupling molded from ASTM C 1440, TPE material with corrosion-resistant-metal tension band and tightening mechanism on each end.

1. Manufacturers:

a. ANACO.

b. Cascade Waterworks Mfg. Co.

c. Mission Rubber Co.

E. Pressure Pipe Couplings: AWWA C219 metal, sleeve-type same size as, with pressure rating at least equal to, and ends compatible with, pipes to be joined.

1. Manufacturers:

a. Cascade Waterworks Mfg. Co.

b. Dresser, Inc.; DMD Div.

c. EBAA Iron Sales, Inc.

d. Ford Meter Box Company, Inc. (The); Pipe Products Div.

e. JCM Industries, Inc.

f. Romac Industries, Inc.

g. Smith-Blair, Inc.

h. Viking Johnson.

2. Center-Sleeve Material: Manufacturer's standard.

3. Gasket Material: Natural or synthetic rubber.

4. Metal Component Finish: Corrosion-resistant coating or material.

F. Flexible Ball Joints: Ductile-iron fitting with combination of flanged and mechanical-joint ends complying with AWWA C110 or AWWA C153. Include gasketed ball-joint section and ductile-iron gland, rubber gasket, and steel bolts.

1. Manufacturers:

a. EBAA Iron Sales, Inc.

b. Romac Industries, Inc.

c. Star Pipe Products; Star Fittings Div.

G. Expansion Joints: Two or three-piece, ductile-iron assembly consisting of telescoping sleeve(s) with gaskets and restrained-type, ductile-iron, bell-and-spigot end sections complying with AWWA C110 or AWWA C153. Select and assemble components for expansion indicated. Include AWWA C111, ductile-iron glands, rubber gaskets, and steel bolts.

1. Manufacturers:

a. EBAA Iron Sales, Inc.

b. Romac Industries, Inc.

c. Star Pipe Products; Star Fittings Div.

H. Wall-Penetration Fittings: Compound, ductile-iron coupling fitting with sleeve and flexing sections for up to 20-degree deflection, gaskets, and restrained-joint ends complying with AWWA C110 or AWWA C153. Include AWWA C111, ductile-iron glands, rubber gaskets, and steel bolts.

1. Manufacturers:

a. SIGMA Corp.

b. EBAA Iron Sales, Inc.

c. Romac Industries, Inc.

2.11 ENCASEMENT FOR UNDERGROUND METAL PIPING

A. Retain this Article if corrosion protection is required for underground metal piping.

B. Description: ASTM A 674 or AWWA C105, high-density, crosslaminated PE film of 0.004-inch or LLDPE film of 0.008-inch minimum thickness.

C. Form: Sheet.

D. Color: Black.

PART 3 - EXECUTION

3.01 EXCAVATION

A. Refer to Division 31 Section "Earth Moving" for excavating, trenching, and backfilling.

3.02 PIPING APPLICATIONS

A. Flanges and unions may be used on aboveground pressure piping, unless otherwise indicated.

B. Aboveground storm drainage piping NPS 6 and smaller shall be any of the following:

1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.

2. Hubless cast-iron soil pipe and fittings; standard shielded, stainless-steel couplings; and coupled joints.

3. Steel pipe, drainage fittings, and threaded joints.

4. Copper DWV tube, copper drainage fittings, and soldered joints.

5. Solid-wall ABS pipe, ABS socket fittings, and solvent-cemented joints.

6. Solid-wall Cellular-core] PVC pipe, PVC socket fittings, and solvent-cemented joints.

7. Dissimilar Pipe-Material Couplings: [Flexible,] [Shielded,] [Rigid, unshielded,] nonpressure pipe couplings for joining dissimilar pipe materials with small difference in OD.

C. Aboveground, storm drainage piping NPS 8 and larger shall be the following:

1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.

2. Hubless cast-iron soil pipe and fittings; standard, shielded, stainless-steel couplings; and coupled joints.

3. Steel pipe, drainage fittings, and threaded joints.

4. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
5. Dissimilar Pipe-Material Couplings: Flexible, nonpressure pipe couplings for joining dissimilar pipe materials with small difference in OD.

D. Underground storm drainage piping NPS 6 and smaller shall be the following:
1. Extra-heavy class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
2. Hubless cast-iron soil pipe and fittings; standard shielded, stainless-steel couplings; and coupled joints.
3. Steel pipe, drainage fittings, and threaded joints.
4. Solid-wall ABS pipe, ABS socket fittings, and solvent-cemented joints.
5. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
6. Dissimilar Pipe-Material Couplings: Flexible nonpressure pipe couplings for joining dissimilar pipe materials with small difference in OD.

E. Underground, storm drainage piping NPS 8 and larger shall be the following:
1. Extra-Heavy class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
2. Hubless cast-iron soil pipe and fittings; standard, shielded, stainless-steel couplings; and coupled joints.
3. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
4. Cellular-core, Sewer and Drain Series, PVC pipe; PVC socket fittings; and solvent-cemented joints.
5. Dissimilar Pipe-Material Couplings: Flexible, nonpressure pipe couplings for joining dissimilar pipe materials with small difference in OD.

F. Aboveground storm drainage force mains NPS 1-1/2 and NPS 2 shall be the following:
1. Hard copper tube, Type L ; copper pressure fittings; and soldered joints.
2. Steel pipe, pressure fittings, and threaded joints.

G. Aboveground storm drainage force mains NPS 2-1/2 and NPS 6 shall be the following:
1. Hard copper tube, Type L; copper pressure fittings; and soldered joints.
2. Steel pipe, pressure fittings, and threaded joints.
3. Grooved-end steel pipe, grooved-joint system fittings and couplings, and grooved joints.

3.03 PIPING INSTALLATION

A. Storm sewer and drainage piping outside the building are specified in Division 33 Section "Storm Utility Drainage Piping."

B. Basic piping installation requirements are specified in Division 22 Section "Common Work Results for Plumbing."

C. Install seismic restraints on piping. Seismic-restraint devices are specified in Division 22 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment."

D. Install cleanouts at grade and extend to where building storm drains connect to building storm sewers. Cleanouts are specified in Division 22 Section "Storm Drainage Piping Specialties."

E. Install cleanout fitting with closure plug inside the building in storm drainage force-main piping.

F. Install underground, steel, force-main piping. Install encasement on piping according to ASTM A 674 or AWWA C105.

G. Install underground, ductile-iron, force-main piping according to AWWA C600. Install buried piping inside building between wall and floor penetrations and connection to storm sewer piping outside building with restrained joints. Anchor pipe to wall or floor. Install thrust-block supports at vertical and horizontal offsets.
1. Install encasement on piping according to ASTM A 674 or AWWA C105.

H. Install underground, copper, force-main tubing according to CDA's "Copper Tube Handbook."

1. Install encasement on piping according to ASTM A 674 or AWWA C105.

I. Install underground, ductile-iron, special pipe fittings according to AWWA C600.

1. Install encasement on piping according to ASTM A 674 or AWWA C105.

J. Install cast-iron sleeve with water stop and mechanical sleeve seal at each service pipe penetration through foundation wall. Select number of interlocking rubber links required to make installation watertight. Sleeves and mechanical sleeve seals are specified in Division 22 Section "Common Work Results for Plumbing."

K. Install wall-penetration fitting system at each service pipe penetration through foundation wall. Make installation watertight.

L. 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."

1. Install encasement on underground piping according to ASTM A 674 or AWWA C105.

M. Make changes in direction for storm drainage piping using appropriate branches, bends, and long-sweep bends. 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.

N. Lay buried building storm drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.

O. Install storm drainage piping at the following minimum slopes, unless otherwise indicated:

1. Building Storm Drain: 1 percent downward in direction of flow for piping NPS 3 and smaller; 1 percent downward in direction of flow for piping NPS 4 and larger.

2. Horizontal Storm-Drainage Piping: 2 percent downward in direction of flow.

P. Install force mains at elevations indicated.

Q. Install engineered controlled-flow storm drainage piping in locations indicated.

R. Sleeves are not required for cast-iron soil piping passing through concrete slabs-on-grade if slab is without membrane waterproofing.

S. Install ABS storm drainage piping according to ASTM D 2661.

T. Install PVC storm drainage piping according to ASTM D 2665.

U. Install underground ABS and PVC storm drainage piping according to ASTM D 2321.

V. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

3.04 JOINT CONSTRUCTION

A. Basic piping joint construction requirements are specified in Division 22 Section "Common Work Results for Plumbing."

B. Hub-and-Spigot, Cast-Iron Soil Piping Gasketed Joints: Join according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.

C. Hub-and-Spigot, Cast-Iron Soil Piping Calked Joints: Join according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for lead and oakum calked joints.

D. Hubless Cast-Iron Soil Piping Coupled Joints: Join according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-coupling joints.

E. Soldered Joints: Use ASTM B 813, water-flushable, lead-free flux; ASTM B 32, lead-free-alloy solder; and ASTM B 828 procedure, unless otherwise indicated.

F. Grooved Joints: Cut groove ends of pipe and assemble grooved ends of pipes, grooved-end fittings, and grooved-end-piping couplings according to AWWA C606.

G. PVC Nonpressure Piping Joints: Join piping according to ASTM D 2665.

3.05 VALVE INSTALLATION

A. General valve installation requirements are specified in Division 22 Section "General-Duty Valves for Plumbing Piping."

B. Shutoff Valves: Install shutoff valve on each sump pump discharge.

1. Install gate or full-port ball valve for piping NPS 2 and smaller.
2. Install gate valve for piping NPS 2-1/2 and larger.

C. Check Valves: Install swing check valve, between pump and shutoff valve, on each sump pump discharge.

D. Backwater Valves: Install backwater valves in piping subject to backflow.

1. Horizontal Piping: Horizontal backwater valves. Use normally closed type, unless otherwise indicated.
2. Install backwater valves in accessible locations.
3. Backwater valve are specified in Division 22 Section "Storm Drainage Piping Specialties."

3.06 HANGER AND SUPPORT INSTALLATION

A. Seismic-restraint devices are specified in Division 22 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment."

B. Pipe hangers and supports are specified in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment." Install the following:

1. Vertical Piping: MSS Type 8 or Type 42, clamps.
2. Individual, Straight, Horizontal Piping Runs: According to the following:
   a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
   b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
   c. Longer Than 100 Feet, if Indicated: MSS Type 49, spring cushion rolls.
3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
4. Base of Vertical Piping: MSS Type 52, spring hangers.

C. Install supports according to Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment."

D. Support vertical piping and tubing at base and at each floor.

E. Rod diameter may be reduced 1 size for double-rod hangers, with 3/8-inch minimum rods.

F. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/2 and NPS 2 : 60 inches with 3/8-inch rod.
2. NPS 3 : 60 inches with 1/2-inch rod.
3. NPS 4 and NPS 5 : 60 inches with 5/8-inch rod.
4. NPS 6: 60 inches with 3/4-inch rod.
5. NPS 8 to NPS 12: 60 inches with 7/8-inch rod.
6. Spacing for 10-foot lengths may be increased to 10 feet. Spacing for fittings is limited to 60 inches.

G. Install supports for vertical cast-iron soil piping every 15 feet.

H. Install hangers for steel piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/4: 84 inches with 3/8-inch rod.
2. NPS 1-1/2: 108 inches with 3/8-inch rod.
3. NPS 2 : 10 feet with 3/8-inch rod.
4. NPS 2-1/2: 11 feet with 1/2-inch rod.
5. NPS 3 : 12 feet with 1/2-inch rod.
6. NPS 4 and NPS 5 : 12 feet with 5/8-inch rod.
7. NPS 6: 12 feet) with 3/4-inch rod.
8. NPS 8 to NPS 12: 12 feet with 7/8-inch rod.

I. Install supports for vertical steel piping every 15 feet.

J. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/4: 72 inches with 3/8-inch rod.
2. NPS 1-1/2 and NPS 2: 96 inches with 3/8-inch rod.
3. NPS 2-1/2: 108 inches with 1/2-inch rod.
4. NPS 3 to NPS 5: 10 feet with 1/2-inch rod.
5. NPS 6: 10 feet with 5/8-inch rod.
6. NPS 8: 10 feet with 3/4-inch rod.

K. Install supports for vertical copper tubing every 10 feet.

L. Install hangers for ABS and PVC piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/2 and NPS 2: 48 inches with 3/8-inch rod.
2. NPS 3: 48 inches with 1/2-inch rod.
3. NPS 4 and NPS 5: 48 inches with 5/8-inch rod.
4. NPS 6: 48 inches with 3/4-inch rod.
5. NPS 8 to NPS 12: 48 inches with 7/8-inch rod.

M. Install supports for vertical [ABS] [and] [PVC] piping every 48 inches.

N. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.07 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect interior storm drainage piping to exterior storm drainage piping. Use transition fitting to join dissimilar piping materials.

C. Connect storm drainage piping to roof drains and storm drainage specialties.

D. Connect force-main piping to the following:

1. Storm Sewer: To exterior force main or storm manhole.
2. Sump Pumps: To sump pump discharge.

3.08 FIELD QUALITY CONTROL

A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.

1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in.

2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.

B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.

C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

D. Test storm drainage piping according to procedures of authorities having jurisdiction or, in absence of published procedures, 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 new, altered, extended, or replaced storm drainage piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.

3. Test Procedure: Test storm drainage piping, except outside leaders, on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water. From 15 minutes before inspection starts to completion of inspection, water level must not drop. Inspect joints for leaks.

4. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.

5. Prepare reports for tests and required corrective action.

E. Test force-main piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:

1. Leave uncovered and unconcealed new, altered, extended, or replaced force-main piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.

2. 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.

3. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.

4. Prepare reports for tests and required corrective action.

3.09 CLEANING

A. Clean interior of piping. Remove dirt and debris as work progresses.

B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.

C. Place plugs in ends of uncompleted piping at end of day and when work stops.

END OF SECTION 22 1413

SECTION 22 3300

ELECTRIC WATER HEATERS

PART 1 - GENERAL

1.01 SUMMARY

A. This Section includes the following:
   1. Commercial, storage electric water heaters.
   2. Water heater accessories.

1.02 SUBMITTALS

A. Product Data: For each type and size of water heater indicated. Include rated capacities, operating characteristics, furnished specialties, and accessories.

B. Shop Drawings: Diagram power, signal, and control wiring.

C. Operation and maintenance data.

D. Warranty.

1.03 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. ASHRAE/IESNA-90.1-2004 Compliance: Applicable requirements in ASHRAE/IESNA 90.1-2004.

C. ASME Compliance: Where ASME-code construction is indicated, fabricate and label commercial water heater storage tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.

D. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9" for all components that will be in contact with potable water.

1.04 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of electric 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 Period(s): From date of Substantial Completion:

      a. Commercial Electric Water Heaters: Five years.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.
2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.02 COMMERCIAL ELECTRIC WATER HEATERS

A. Commercial, Storage Electric Water Heaters: Comply with UL 1453 requirements for storage-tank-type water heaters.

1. Manufacturers:

   a. Smith, A. O. Smith Water Products Company.
   b. Bradford White Corporation.
   c. State Industries, Inc.

2. Storage-Tank Construction: Non-ASME-code, steel vertical arrangement.

   a. Tappings: Factory fabricated of materials compatible with tank and piping connections. Attach tappings to tank before testing.

      1) NPS 2 (DN 50) and Smaller: Threaded ends according to ASME B1.20.1.
      2) NPS 2-1/2 (DN 65) and Larger: Flanged ends according to ASME B16.5 for steel and stainless-steel flanges, and according to ASME B16.24 for copper and copper-alloy flanges.

   b. Pressure Rating: 150 psig (1035 kPa).
   c. Interior Finish: Comply with NSF 61 barrier materials for potable-water tank linings, including extending lining material into tappings.

3. Factory-Installed Storage-Tank Appurtenances:

   a. Anode Rod: Replaceable magnesium.
   b. Drain Valve: Corrosion-resistant metal complying with ASSE 1005.
   c. Insulation: Comply with ASHRAE/IESNA 90.1.
   d. Jacket: Steel with enameled finish.
   e. Heating Elements: Electric, screw-in or bolt-on immersion type arranged in multiples of three.
   f. Temperature Control: Adjustable thermostat.
   g. Safety Controls: High-temperature-limit and low-water cutoff devices or systems.
   h. Relief Valves: ASME rated and stamped and complying with ASME PTC 25.3, for combination temperature and pressure relief valves. Include one or more relief valves with total relieving capacity at least as great as heat input, and include pressure setting less than water heater working-pressure rating. Select one relief valve with sensing element that extends into storage tank.

4. Special Requirements: NSF 5 construction.
5. Building Automation System Interface: Normally closed dry contacts for enabling and disabling water heater.
6. Capacity and Characteristics as scheduled on plans:

2.03 WATER HEATER ACCESSORIES

A. Water Heater Stands: Water heater manufacturer's factory-fabricated steel stand for floor mounting and capable of supporting water heater and water. Include dimension that will support bottom of water heater a minimum of 18 inches (457 mm) above the floor.

B. Water Heater Mounting Brackets: Water heater manufacturer's factory-fabricated steel bracket for wall mounting and capable of supporting water heater and water.

C. Drain Pans: Corrosion-resistant metal with raised edge. Include dimensions not less than base of water heater and include drain outlet not less than NPS 3/4 (DN 20).

D. Piping-Type Heat Traps: Field-fabricated piping arrangement according to ASHRAE/IESNA 90.1-2004 or ASHRAE 90.2-2004.

PART 3 - EXECUTION

3.01 WATER HEATER INSTALLATION

A. Install commercial water heaters on concrete bases.

1. Exception: Omit concrete bases for commercial water heaters if installation on stand, bracket, suspended platform, or direct on floor is indicated.
2. Concrete base construction requirements are specified in Division 22 Section "Common Work Results for Plumbing."

B. Install water heaters level and plumb, according to layout drawings, original design, and referenced standards. Maintain manufacturer's recommended clearances. Arrange units so controls and devices needing service are accessible.

C. Install combination temperature and pressure relief valves in top portion of storage tanks. Use relief valves with sensing elements that extend into tanks. Extend commercial, water-heater, relief-valve outlet, with drain piping same as domestic water piping in continuous downward pitch, and discharge by positive air gap onto closest floor drain.

D. Install water heater drain piping as indirect waste to spill by positive air gap into open drains or over floor drains. Install hose-end drain valves at low points in water piping for water heaters that do not have tank drains. Refer to Division 22 Section "Domestic Water Piping Specialties" for hose-end drain valves.

E. Install thermometer on outlet piping of water heaters. Refer to Division 22 Section "Meters and Gages for Plumbing Piping" for thermometers.

F. Install water regulator, with integral bypass relief valve, in booster-heater inlet piping and water hammer arrester in booster-heater outlet piping.

G. Install piping-type heat traps on inlet and outlet piping of water heater storage tanks without integral or fitting-type heat traps.

H. Fill water heaters with water.

3.02 CONNECTIONS

A. Install piping adjacent to water heaters to allow service and maintenance. Arrange piping for easy removal of water heaters.

B. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

C. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.03 FIELD QUALITY CONTROL

A. Engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including connections.

B. Perform the following field tests and inspections:

1. Leak Test: After installation, test for leaks. Repair leaks and retest until no leaks exist.
2. Operational Test: After electrical circuitry has been energized, confirm proper operation.

3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

C. Remove and replace water heaters that do not pass tests and inspections and retest as specified above.

3.04 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain commercial electric water heaters. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION

SECTION 22 4000
PLUMBING FIXTURES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. This Section includes the following conventional plumbing fixtures and related components:

1. Faucets for lavatories, showers and sinks.
2. Flushometers.
3. Toilet seats.
4. Protective shielding guards.
5. Fixture supports.
6. Water closets.
7. Urinals.
8. Lavatories.
9. Individual showers.
10. Service sinks.
11. Service basins.

B. Related Sections include the following:

1. Division 10 Section "Toilet, Bath, and Laundry Accessories."
2. Division 22 Section "Domestic Water Piping Specialties" for backflow preventers, floor drains, and specialty fixtures not included in this Section.
3. Division 22 Section "Security Plumbing Fixtures."
4. Division 22 Section "Drinking Fountains and Water Coolers."

1.03 DEFINITIONS

A. ABS: Acrylonitrile-butadiene-styrene plastic.

B. Accessible Fixture: Plumbing fixture that can be approached, entered, and used by people with disabilities.

C. Cast Polymer: Cast-filled-polymer-plastic material. This material includes cultured-marble and solid-surface materials.

D. Cultured Marble: Cast-filled-polymer-plastic material with surface coating.

E. Fitting: Device that controls the flow of water into or out of the plumbing fixture. Fittings specified in this Section include supplies and stops, faucets and spouts, shower heads and tub spouts, drains and tailpieces, and traps and waste pipes. Piping and general-duty valves are included where indicated.

F. FRP: Fiberglass-reinforced plastic.

G. PMMA: Polymethyl methacrylate (acrylic) plastic.

H. PVC: Polyvinyl chloride plastic.

I. Solid Surface: Nonporous, homogeneous, cast-polymer-plastic material with heat-, impact-, scratch-, and stain-resistance qualities.

1.04 SUBMITTALS

A. Product Data: For each type of plumbing fixture indicated. Include selected fixture and trim, fittings, accessories, appliances, appurtenances, equipment, and supports. Indicate materials and finishes, dimensions, construction details, and flow-control rates.

B. Shop Drawings: Diagram power, signal, and control wiring.

C. Operation and Maintenance Data: For plumbing fixtures to include in emergency, operation, and maintenance manuals.

D. Warranty: Special warranty specified in this Section.

1.05 QUALITY ASSURANCE

A. Source Limitations: Obtain plumbing fixtures, faucets, and other components of each category through one source from a single manufacturer.

1. Exception: If fixtures, faucets, or other components are not available from a single manufacturer, obtain similar products from other manufacturers specified for that category.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Regulatory Requirements: Comply with requirements in Americans with Disabilities Act and Architectural Barriers Act Accessibility Guidelines (36 CFR, Part 1191: ADAABAAG); ICC A117.1, "Accessible and Usable Buildings and Facilities"[; Public Law 90-480, "Architectural Barriers Act"; and Public Law 101-336, "Americans with Disabilities Act";] for plumbing fixtures for people with disabilities.

D. Regulatory Requirements: Comply with requirements in Public Law 102-486, "Energy Policy Act," about water flow and consumption rates for plumbing fixtures.

E. NSF Standard: Comply with NSF 61, "Drinking Water System Components--Health Effects," for fixture materials that will be in contact with potable water.

F. Select combinations of fixtures and trim, faucets, fittings, and other components that are compatible.

G. Comply with the following applicable standards and other requirements specified for plumbing fixtures:

1. Enameled, Cast-Iron Fixtures: ASME A112.19.1M.
2. Plastic Lavatories: ANSI Z124.3.
3. Plastic Laundry Trays: ANSI Z124.6.
4. Plastic Mop-Service Basins: ANSI Z124.6.
5. Plastic Shower Enclosures: ANSI Z124.2.
6. Plastic Sinks: ANSI Z124.6.
7. Plastic Urinal Fixtures: ANSI Z124.9.
8. Porcelain-Enameled, Formed-Steel Fixtures: ASME A112.19.4M.
9. Slip-Resistant Bathing Surfaces: ASTM F 462.
10. Solid-Surface-Material Lavatories and Sinks: ANSI/ICPA SS-1.
11. Stainless-Steel Commercial, Handwash Sinks: NSF 2 construction.
12. Stainless-Steel Residential Sinks: ASME A112.19.3.
13. Vitreous-China Fixtures: ASME A112.19.2M.
14. Water-Closet, Flush Valve, Tank Trim: ASME A112.19.5.
15. Water-Closet, Flushometer Tank Trim: ASSE 1037.
16. Whirlpool Bathtub Fittings: ASME A112.19.8M.

H. Comply with the following applicable standards and other requirements specified for [lavatory] [and] [sink] faucets:

1. Backflow Protection Devices for Faucets with Side Spray: ASME A112.18.3M.
2. Backflow Protection Devices for Faucets with Hose-Thread Outlet: ASME A112.18.3M.
3. Diverter Valves for Faucets with Hose Spray: ASSE 1025.
4. Faucets: ASME A112.18.1.
5. Hose-Connection Vacuum Breakers: ASSE 1011.
6. Hose-Coupling Threads: ASME B1.20.7.
7. Integral, Atmospheric Vacuum Breakers: ASSE 1001.
8. NSF Potable-Water Materials: NSF 61.
9. Pipe Threads: ASME B1.20.1.
10. Sensor-Actuated Faucets and Electrical Devices: UL 1951.
11. Supply Fittings: ASME A112.18.1.
12. Brass Waste Fittings: ASME A112.18.2.

I. Comply with the following applicable standards and other requirements specified for [bathtub] [bathtub/shower] [and] [shower] faucets:

1. Backflow Protection Devices for Hand-Held Showers: ASME A112.18.3M.
2. Combination, Pressure-Equalizing and Thermostatic-Control Antiscald Faucets: ASSE 1016.
3. Deck-Mounted Bath/Shower Transfer Valves: ASME 18.7.
4. Faucets: ASME A112.18.1.
5. Hand-Held Showers: ASSE 1014.
6. High-Temperature-Limit Controls for Thermal-Shock-Preventing Devices: ASTM F 445.
7. Hose-Coupling Threads: ASME B1.20.7.
8. Manual-Control Antiscald Faucets: ASTM F 444.
9. Pipe Threads: ASME B1.20.1.
10. Pressure-Equalizing-Control Antiscald Faucets: ASTM F 444 and ASSE 1016.
11. Sensor-Actuated Faucets and Electrical Devices: UL 1951.
12. Thermostatic-Control Antiscald Faucets: ASTM F 444 and ASSE 1016.

J. Comply with the following applicable standards and other requirements specified for miscellaneous fittings:

1. Atmospheric Vacuum Breakers: ASSE 1001.
2. Brass and Copper Supplies: ASME A112.18.1.
3. Dishwasher Air-Gap Fittings: ASSE 1021.
4. Manual-Operation Flushometers: ASSE 1037.
5. Plastic Tubular Fittings: ASTM F 409.
6. Brass Waste Fittings: ASME A112.18.2.
7. Sensor-Operation Flushometers: ASSE 1037 and UL 1951.

K. Comply with the following applicable standards and other requirements specified for miscellaneous components:

1. Disposers: ASSE 1008 and UL 430.
2. Dishwasher Air-Gap Fittings: ASSE 1021.
3. Flexible Water Connectors: ASME A112.18.6.

4. Floor Drains: ASME A112.6.3.
5. Grab Bars: ASTM F 446.
6. Hose-Coupling Threads: ASME B1.20.7.
7. Hot-Water Dispensers: ASSE 1023 and UL 499.
8. Off-Floor Fixture Supports: ASME A112.6.1M.
9. Pipe Threads: ASME B1.20.1.
10. Plastic Shower Receptors: ANSI Z124.2.
11. Plastic Toilet Seats: ANSI Z124.5.
12. Supply and Drain Protective Shielding Guards: ICC A117.1.
13. Whirlpool Bathtub Equipment: UL 1795.

1.06 WARRANTY

A. Special Warranties: Manufacturer's standard form in which manufacturer agrees to repair or replace components of whirlpools that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:
   a. Structural failures of unit shell.
   b. Faulty operation of controls, blowers, pumps, heaters, and timers.
   c. Deterioration of metals, metal finishes, and other materials beyond normal use.
2. Warranty Period for Commercial Applications: One year(s) from date of Substantial Completion.

1.07 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: Equal to [10] <Insert number> percent of amount of each type and size installed.
2. Faucet Cartridges and O-Rings: Equal to [5] <Insert number> percent of amount of each type and size installed.
3. Flushometer Valve, Repair Kits: Equal to 10 percent of amount of each type installed, but no fewer than 12 of each type.
4. Provide hinged-top wood or metal box, or individual metal boxes, with separate compartments for each type and size of extra materials listed above.
5. Flushometer Tank, Repair Kits: Equal to 5 percent of amount of each type installed, but no fewer than 2 of each type.
6. Water-Closet Tank, Repair Kits: Equal to 5 percent of amount of each type installed.
7. Toilet Seats: Equal to 5 percent of amount of each type installed.

PART 2 - PRODUCTS

2.01 LAVATORY FAUCETS

A. Lavatory Faucets:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
3. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:

a. American Standard Companies, Inc.
b. Bradley Corporation.
c. Chicago Faucets.
d. Delta Faucet Company.
e. Eljer.
f. Elkay Manufacturing Co.
g. Fisher Manufacturing Co.
h. Grohe America, Inc.
i. Just Manufacturing Company.
j. Kohler Co.
k. Moen, Inc.
l. Royal Brass Mfg. Co.
m. Sayco; a Briggs Plumbing Products, Inc. Company.
n. Speakman Company.
o. T & S Brass and Bronze Works, Inc.
p. Zurn Plumbing Products Group; Commercial Brass Operation.
q. Brasstech Inc.; Newport Brass Div.
r. Broadway Collection.
s. Central Brass Manufacturing Company.
t. Eljer.
u. Franke Consumer Products, Inc.; Kitchen Systems Div.
v. Gerber Plumbing Fixtures LLC.
w. Geberit Manufacturing, Inc.
x. Hansgrohe Inc.
y. Hydrotek International, Inc.
z. Intersan Manufacturing Company.
aa. Pegler, Ltd.
bb. Price Pfister, Inc.
cc. Rohl LLC.
dd. Royal Brass Mfg. Co.
ee. Sayco; a Briggs Plumbing Products, Inc. Company.
ff. Speakman Company.
gg. Wolverine Brass, Inc.

4. Description: Two-handle mixing valve. Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture holes; coordinate outlet with spout and fixture receptor.
   a. Body Material: Commercial, solid brass.
   b. Finish: Polished chrome plate.
   c. Centers: 4 inches (102 mm), Single Hole.
   d. Mounting: See drawings.
   e. Valve Handle(s): Lever, Wrist blade, 4 inches (102 mm.
   f. Inlet(s): NPS 3/8 (DN 10) tubing, plain end.

g. Spout: Rigid type.

h. Spout Outlet: Aerator.

i. Operation: Compression, manual.

j. Drain: Grid

k. Tempering Device: Thermostatic.

2.02 SHOWER FAUCETS

A. Shower Faucets:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

3. Basis-of-Design Product: Subject to compliance with requirements, provide [the product indicated on Drawings] <Insert manufacturer's name; product name or designation> or a comparable product by one of the following:

a. American Standard Companies, Inc.

b. Brasstech Inc.; Newport Brass Div.

c. Broadway Collection.

d. Central Brass Manufacturing Company.

e. Chicago Faucets.

f. Delta Faucet Company.

g. Eljer.

h. Gerber Plumbing Fixtures LLC.

i. Hansgrohe Inc.

j. Kohler Co.

k. Leonard Valve Company.

l. Moen, Inc.

m. Paul Decorative Products.

n. Pegler, Ltd.

o. Powers; a Watts Industries Co.

p. Price Pfister, Inc.

q. Rohl LLC.

r. Royal Brass Mfg. Co.

s. Sayco; a Briggs Plumbing Products, Inc. Company.

t. Speakman Company.

u. Sterling Plumbing Group, Inc.

v. St. Thomas Creations.

w. Symmons Industries, Inc.

x. T & S Brass and Bronze Works, Inc.

y. Wolverine Brass, Inc.

z. Zurn Plumbing Products Group; AquaSpec Commercial Faucet Operation.

aa. Zurn Plumbing Products Group; Wilkins Operation.

4. Description: Single-handle thermostatic valve. Include hot- and cold-water indicators; check stops; and shower head, arm, and flange. Coordinate faucet inlets with supplies and outlet with diverter valve.
    a. Body Material: Solid brass.
    b. Finish: Polished chrome plate.
    c. Operation: Compression, manual.
    d. Antiscald Device: Integral with mixing valve.
    e. Check Stops: Check-valve type, integral with or attached to body; on hot- and cold-water supply connections.
    f. Supply Connections: NPS 1/2 (DN 15.
    g. Shower Head Type: Ball joint.
    h. Shower Head Material: Metallic with chrome-plated finish.
    i. Spray Pattern: Fixed.

2.03 FLUSHOMETERS

A. Flushometers:
1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
3. Basis-of-Design Product: Subject to compliance with requirements, provide [the product indicated on Drawings] <Insert manufacturer's name; product name or designation> or a comparable product by one of the following:
    a. Coyne & Delany Co.
    b. Delta Faucet Company.
    c. Sloan Valve Company.
    d. Zurn Plumbing Products Group; Commercial Brass Operation.
    e. Hydrotek International, Inc.
    f. Sloan Valve Company.
    g. TOTO USA, Inc.
    h. Coyne & Delany Co.
    i. Delta Faucet Company.
    j. Hydrotek International, Inc.
    k. Sloan Valve Company.
    l. TOTO USA, Inc.
    m. Zurn Plumbing Products Group; Commercial Brass Operation.
4. Description: Flushometer for urinal and/or water-closet-type fixture. Include brass body with corrosion-resistant internal components, control stop with check valve, vacuum breaker, copper or brass tubing, and polished chrome-plated finish on exposed parts.
    a. Internal Design: Diaphragm operation.
    b. Style: Exposed and or Concealed.
    c. Inlet Size: NPS 3/4 (DN 20.
    d. Trip Mechanism: Oscillating, lever-handle actuator.
    e. Tailpiece Size: NPS 3/4 (DN 20 length to top of bowl.

2.04 TOILET SEATS

A. Toilet Seats:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
3. Basis-of-Design Product: Subject to compliance with requirements, provide [the product indicated on Drawings] <Insert manufacturer's name; product name or designation> or a comparable product by one of the following:
    a. American Standard Companies, Inc.
    b. Bemis Manufacturing Company.
    c. Centoco Manufacturing Corp.
    d. Church Seats.
    e. Eljer.
    f. Kohler Co.
    g. Olsonite Corp.
    h. Sanderson Plumbing Products, Inc.; Beneke Div.
    i. Sperzel.
    j. Bemis Manufacturing Company.
    k. Centoco Manufacturing Corp.
    l. Church Seats.
    m. Kohler Co.
    n. Olsonite Corp.
    o. Pressalit A/S.
    p. Sanderson Plumbing Products, Inc.; Beneke Div.
    q. Sperzel.

2.05 PROTECTIVE SHIELDING GUARDS

A. Protective Shielding Pipe Covers, :

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    a. Engineered Brass Co.
    b. Insul-Tect Products Co.; a Subsidiary of MVG Molded Products.
    c. McGuire Manufacturing Co., Inc.
    d. Plumberex Specialty Products Inc.
    e. TCI Products.
    f. TRUEBRO, Inc.
    g. Zurn Plumbing Products Group; Tubular Brass Plumbing Products Operation.
3. Description: Manufactured plastic wraps for covering plumbing fixture [hot-water supply] [hot- and cold-water supplies] and trap and drain piping. Comply with Americans with Disabilities Act (ADA) requirements.

B. Protective Shielding Piping Enclosures, <Insert drawing designation>:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. TRUEBRO, Inc.
3. Description: Manufactured plastic enclosure for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with ADA requirements.

2.06 FIXTURE SUPPORTS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Josam Company.
2. MIFAB Manufacturing Inc.
3. Smith, Jay R. Mfg. Co.
4. Tyler Pipe; Wade Div.
5. Watts Drainage Products Inc.; a div. of Watts Industries, Inc.
6. Zurn Plumbing Products Group; Specification Drainage Operation.

C. Water-Closet Supports:

1. Description: Combination carrier designed for [accessible] [standard] mounting height of wall-mounting, water-closet-type fixture. Include single or double, vertical or horizontal, hub-and-spigot or hubless waste fitting as required for piping arrangement; faceplates; couplings with gaskets; feet; and fixture bolts and hardware matching fixture. Include additional extension coupling, faceplate, and feet for installation in wide pipe space.

D. Urinal Supports:

1. Description: Type [I, urinal carrier with fixture support plates and coupling with seal and fixture bolts and hardware matching fixture] [II, urinal carrier with hanger and bearing plates] for wall-mounting, urinal-type fixture. Include steel uprights with feet.
2. Accessible-Fixture Support: Include rectangular steel uprights.

E. Lavatory Supports, <Insert drawing designation>:

1. Description: Type [I, lavatory carrier with exposed arms and tie rods] [II, lavatory carrier with concealed arms and tie rod] [III, lavatory carrier with hanger plate and tie rod] for wall-mounting, lavatory-type fixture. Include steel uprights with feet.
2. Accessible-Fixture Support: Include rectangular steel uprights.

F. Sink Supports, <Insert drawing designation>:

1. Description: Type [I, sink carrier with exposed arms and tie rods] [II, sink carrier with hanger plate, bearing studs, and tie rod] [III, sink carrier with hanger plate and exposed arms] for sink-type fixture. Include steel uprights with feet.

2.07 SHOWER RECEPTORS

A. Shower Receptors:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

3. Basis-of-Design Product: Subject to compliance with requirements, provide or a comparable product by one of the following:

    a. Crane Plumbing, L.L.C./Fiat Products.

    b. Florestone Products Co., Inc.

    c. Aker Plastics Co., Inc.

    d. Crane Plumbing, L.L.C./Fiat Products.

    e. LASCO Bathware.

    f. Mustee, E. L. & Sons, Inc.

    g. Sterling Plumbing Group, Inc.

    h. Swan Corporation (The).

    i. Acryline USA, Inc.

    j. American Standard Companies, Inc.

    k. Jacuzzi, Inc.

    l. Jason International, Inc.

    m. Kohler Co.

    n. Praxis Industries, Inc.; Aquarius Products.

    o. Royal Baths Manufacturing Co.

    p. Acorn Engineering Company.

    q. Precast Terrazzo Enterprises, Inc.

    r. Stern-Williams Co., Inc.

    s. Bradley Corporation.

    t. Formica Corporation.

    u. Lippert Corporation.

4. Description: Cast-polymer base for built-up-type shower fixture.

    a. Type: Handicapped/wheelchair.

2.08 WATER CLOSETS

A. Water Closets:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

3. Basis-of-Design Product: Subject to compliance with requirements, provide [the product indicated on Drawings] <Insert manufacturer's name; product name or designation> or a comparable product by one of the following:

    a. American Standard Companies, Inc.

    b. Barclay Products, Ltd.

    c. Briggs Plumbing Products, Inc.

    d. Crane Plumbing, L.L.C./Fiat Products.

    e. Duravit USA, Inc.

    f. Eljer.

g. Gerber Plumbing Fixtures LLC.
h. Kohler Co.
i. Mansfield Plumbing Products, Inc.
j. Peerless Pottery, Inc.
k. Sanitarios Azteca, S.A. de C.V.
l. Sterling Plumbing Group, Inc.
m. St. Thomas Creations.
n. TOTO USA, Inc.
o. Water Management, Inc.
p. Capizzi.
q. St. Thomas Creations.
r. American Standard Companies, Inc.
s. Gerber Plumbing Fixtures LLC.
t. Kohler Co.
u. Mansfield Plumbing Products, Inc.
v. St. Thomas Creations.
w. <Insert manufacturer's name.>
x. Crane Plumbing, L.L.C./Fiat Products.
y. Eljer.
z. Peerless Pottery, Inc.
aa. Water Management, Inc.
bb. Briggs Plumbing Products, Inc.
cc. American Standard Companies, Inc.
dd. Briggs Plumbing Products, Inc.
ee. Capizzi.
ff. Crane Plumbing, L.L.C./Fiat Products.
gg. Eljer.
hh. Kohler Co.
ii. Mansfield Plumbing Products, Inc.
jj. Peerless Pottery, Inc.
kk. Sanitarios Azteca, S.A. de C.V.
ll. St. Thomas Creations.
mm. TOTO USA, Inc.

4. Description Floor-mounting, floor-outlet, vitreous-china fixture designed for flushometer valve operation.
   a. Style: Flushometer valve.
      1) Bowl Type: Elongated with siphon-jet design. Include bolt caps matching fixture.
      2) Height: Accessible and Juvenile.
      3) Design Consumption: 1.6 gal./flush.
      4) Color: [White] <Insert color>.

2.09 URINALS

A. Urinals:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
3. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
    a. American Standard Companies, Inc.
    b. Briggs Plumbing Products, Inc.
    c. Capizzi.
    d. Crane Plumbing, L.L.C./Fiat Products.
    e. Duravit USA, Inc.
    f. Eljer.
    g. Kohler Co.
    h. Mansfield Plumbing Products, Inc.
    i. Peerless Pottery, Inc.
    j. Sanitarios Azteca, S.A. de C.V.
    k. St. Thomas Creations.
    l. TOTO USA, Inc.
4. Description: Accessible, wall fixture designed for flushometer valve operation.
    a. Type: Siphon jet Siphon jet with extended shields.
    b. Strainer or Trapway: [Integral cast with integral trap.

2.010 LAVATORIES

A. Lavatories:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
3. Basis-of-Design Product: Subject to compliance with requirements, provide [the product indicated on Drawings] <Insert manufacturer's name; product name or designation> or a comparable product by one of the following:
    a. Crane Plumbing, L.L.C./Fiat Products.
    b. RSI Home Products.
    c. Rynone Manufacturing Corp.
    d. Avonite, Inc.
    e. DuPont, Corian Products.
    f. Formica Corporation.
    g. Lippert Corporation.
    h. Swan Corporation (The).
    i. Wilsonart International.
4. Description: Accessible countertop with integral bowl fixtures for mounting on base unit.

a. Backsplash: [Integral with countertop] [Separate, same material as countertop] [Not required].

b. Overall Rectangular Top .

c. Faucet Hole Punching: See drawings

d. Faucet Hole Location: See drawings

e. Faucet(s): See drawings

f. Supplies: NPS 3/8 (DN 10) chrome-plated copper with stops.

g. Drain(s): [See faucets] [Grid] [Grid with offset waste] <Insert drain>.

1) Location: See drawings

h. Drain Piping: See drawings

2.011 SERVICE BASINS

A. Service Basins:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

3. Basis-of-Design Product: Subject to compliance with requirements, provide [the product indicated on Drawings] <Insert manufacturer's name; product name or designation> or a comparable product by one of the following:

a. Acorn Engineering Company.

b. Crane Plumbing, L.L.C./Fiat Products.

c. Florestone Products Co., Inc.

d. Precast Terrazzo Enterprises, Inc.

e. Stern-Williams Co., Inc.

f. Crane Plumbing, L.L.C./Fiat Products.

g. Florestone Products Co., Inc.

h. Mustee, E. L. & Sons, Inc.

i. Swan Corporation (The).

j. Zurn Plumbing Products Group; Light Commercial Operation.

4. Description: Flush-to-wall, floor-mounting, [precast terrazzo] [cast-polymer] fixture with rim guard.

a. Shape: See drawings

b. Size: See drawings

c. Height: [See drawings.

d. Tiling Flange: See drawings.

e. Rim Guard: See drawings.

f. Color: [Not applicable] <Insert color>.

g. Faucet: Sink See drawings .

h. Drain: See drawings.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before plumbing fixture installation.

B. Examine cabinets, counters, floors, and walls for suitable conditions where fixtures will be installed.

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

3.02 INSTALLATION

A. Assemble plumbing fixtures, trim, fittings, and other components according to manufacturers' written instructions.

B. Install off-floor supports, affixed to building substrate, for wall-mounting fixtures.

1. Use carrier supports with waste fitting and seal for back-outlet fixtures.
2. Use carrier supports without waste fitting for fixtures with tubular waste piping.
3. Use chair-type carrier supports with rectangular steel uprights for accessible fixtures.

C. Install back-outlet, wall-mounting fixtures onto waste fitting seals and attach to supports.

D. Install floor-mounting fixtures on closet flanges or other attachments to piping or building substrate.

E. Install wall-mounting fixtures with tubular waste piping attached to supports.

F. Install floor-mounting, back-outlet water closets attached to building floor substrate and wall bracket and onto waste fitting seals.

G. Install counter-mounting fixtures in and attached to casework.

H. Install fixtures level and plumb according to roughing-in drawings.

I. 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, gate, or globe valves if supply stops are not specified with fixture. Valves are specified in Division 22 Section "General-Duty Valves for Plumbing Piping."

J. Install trap and tubular waste piping on drain outlet of each fixture to be directly connected to sanitary drainage system.

K. Install tubular waste piping on drain outlet of each fixture to be indirectly connected to drainage system.

L. Install flushometer valves for accessible water closets and urinals with handle mounted on wide side of compartment. Install other actuators in locations that are easy for people with disabilities to reach.

M. Install tanks for accessible, tank-type water closets with lever handle mounted on wide side of compartment.

N. Install toilet seats on water closets.

O. Install trap-seal liquid in dry urinals.

P. 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.

Q. Install water-supply flow-control fittings with specified flow rates in fixture supplies at stop valves.

R. 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.

S. Install shower flow-control fittings with specified maximum flow rates in shower arms.

T. Install traps on fixture outlets.

1. Exception: Omit trap on fixtures with integral traps.
2. Exception: Omit trap on indirect wastes, unless otherwise indicated.

U. Install disposer in outlet of each sink indicated to have disposer. Install switch where indicated or in wall adjacent to sink if location is not indicated.

V. Install dishwasher air-gap fitting at each sink indicated to have air-gap fitting. Install [in sink deck] [on countertop at sink] <Insert location>. Connect inlet hose to dishwasher and outlet hose to disposer.

W. Install hot-water dispensers in back top surface of sink or in countertop with spout over sink.

X. 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. Escutcheons are specified in Division 22 Section "Common Work Results for Plumbing."

Y. Transfer showers that are to be H.C. accessible are to be 36” x 36”. (See ADAABAAG 608.2.1 and DSRM comment on Sheet A103C)

Z. H.C. accessible roll-in showers are to be 60” (min) wide. (ADAABAAG 608.2.2)

AA. Set [shower receptors] [and] [service basins] in leveling bed of cement grout. Grout is specified in Division 22 Section "Common Work Results for Plumbing."

BB. Seal joints between fixtures and walls, floors, and countertops using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Sealants are specified in Division 07 Section "Joint Sealants."

3.03 CONNECTIONS

A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.

C. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

D. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.04 FIELD QUALITY CONTROL

A. Verify that installed plumbing fixtures are categories and types specified for locations where installed.

B. Check that plumbing fixtures are complete with trim, faucets, fittings, and other specified components.

C. Inspect installed plumbing fixtures for damage. Replace damaged fixtures and components.

D. Test installed fixtures after water systems are pressurized for proper operation. Replace malfunctioning fixtures and components, then retest. Repeat procedure until units operate properly.

E. Install fresh batteries in sensor-operated mechanisms.

3.05 ADJUSTING

A. Operate and adjust faucets and controls. Replace damaged and malfunctioning fixtures, fittings, and controls.

B. Operate and adjust [disposers] [hot-water dispensers] [and] [controls]. Replace damaged and malfunctioning units[and controls].

C. Adjust water pressure at [faucets] [and] [flushometer valves] to produce proper flow and stream.

D. Replace washers and seals of leaking and dripping faucets and stops.

E. Install fresh batteries in sensor-operated mechanisms.

3.06 CLEANING

A. Clean fixtures, faucets, and other fittings with manufacturers' recommended cleaning methods and materials. 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.

B. After completing installation of exposed, factory-finished fixtures, faucets, and fittings, inspect exposed finishes and repair damaged finishes.

3.07 PROTECTION

A. Provide protective covering for installed fixtures and fittings.

B. Do not allow use of plumbing fixtures for temporary facilities unless approved in writing by Owner.

END OF SECTION 22 4000

SECTION 23-0000

BASIC MECHANICAL REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Basic Mechanical Requirements specifically applicable to Division 23 Sections, in addition to Division 01 - General Requirements.

1.02 RELATED DOCUMENTS:

A. THE UNIFORM GENERAL CONDITIONS, SUPPLEMENTARY GENERAL CONDITIONS, and DIVISION 01 of the Specifications apply to the work specified in this Section.

B. All work covered by this Section of these Specifications shall be accomplished in accordance with all applicable provisions of the Contract Documents and any addenda or directives which may be issued herewith, or otherwise.

1.03 GENERAL:

A. The Contractor shall execute all work hereinafter specified or indicated on accompanying Drawings. Contractor shall provide all equipment necessary and usually furnished in connection with such work and systems whether or not mentioned specifically herein or on the Drawings.

B. The Contractor shall be responsible for fitting his material and apparatus into the building and shall carefully lay out his work at the site to conform to the structural conditions, to avoid all obstructions, to conform to the details of the installation and thereby to provide an integrated satisfactory operating installation.

C. The Mechanical, Plumbing, and associated Drawings are necessarily diagrammatic by their nature, and are not intended to show every connection in detail or every pipe or conduit in its exact location. These details are subject to the requirements of standards referenced elsewhere in these specifications, and structural and architectural conditions. The Contractor shall carefully investigate structural and finish conditions and shall coordinate the separate trades in order to avoid interference between the various phases of work. Work shall be organized and laid out so that it will be concealed in furred chases and suspended ceilings, etc., in finished portions of the building, unless specifically noted to be exposed. All exposed work shall be installed parallel or perpendicular to the lines of the building unless otherwise noted.

D. When the mechanical and electrical Drawings do not give exact details as to the elevation of pipe, conduit and ducts, the Contractor shall physically arrange the systems to fit in the space available at the elevations intended with proper grades for the functioning of the system involved. Piping, exposed conduit and the duct systems are generally intended to be installed true and square to the building construction, and located as high as possible against the structure in a neat and workmanlike manner. The Drawings do not show all required offsets, control lines, pilot lines and other location details. Work shall be concealed in all finished areas.

1.04 DEFINITIONS: (Note: These definitions are included here to clarify the direction and intention of this specification. The list given here is not by any means complete. For further clarification as required, contractor shall contact the designated owner's representative.)

A. CONCEALED / EXPOSED: ~ areas are those areas which cannot be seen by the building occupants. Exposed areas are all areas which are exposed to view by the building occupants, including under counters, inside cabinets and closets, plus all mechanical rooms.

B. General Requirements: The provisions of requirements of other Division 01 sections apply to entire work of contract and, where so indicated, to other elements which are included in project. Basic contract definitions are included in the General Conditions.

C. Indicated: The term "indicated" is a cross reference to graphic representations, notes or schedules on drawings, to other paragraphs or schedules in the Specifications, and to similar means of recording requirements on contract documents. Where terms such as "shown", "noted", "scheduled", and "specified" are used in lieu of "indicated", it is for the purpose of helping reader locate the cross reference, and no limitation of location is intended except as specifically noted.

D. Directed, requested, etc.: Where not otherwise explained, terms such as "directed", "requested", "authorized", "selected", "approved", "required", "accepted", and "permitted" mean directed by Architect/Engineer", "requested by Architect/Engineer" and similar phrases. However, no such implied meaning will be interpreted to extend Architect's/Engineer's responsibility into Contractor's area of construction supervision and job safety.

E. And/Or: Where "and/or" is used in these Specifications or on the Drawings, it shall mean "that situations exist where either one or both conditions occur or are required and shall not be interpreted to permit an option on the part of the Contractor.

F. Approve: Where used in conjunction with Architect's/Engineer's response to submittals, requests, applications, inquiries, reports and claims by Contractor, the meaning of term "approved" will be held to limitations to Architect's/Engineer's responsibilities and duties as specified in General and Supplementary Conditions. In no case will "approval" by Architect/Engineer be interpreted as a release of Contractor from responsibilities to fulfill requirements of contract documents or to extend Architect's/Engineer's responsibility into Contractor's area of construction supervision and job safety.

G. As required: Where "as required" is used in these Specifications or on the drawings, it shall mean "that situations exist that are not necessarily described in detail or indicated that may cause the contractor certain complications in performing the work described or indicated. These complications entail the normal coordination activities expected of the Contractor where multiple trades are involved and new or existing construction causes deviations to otherwise simplistic approaches to the work to be performed. The term shall not be interpreted to permit an option on the part of the Contractor to achieve the end result."

H. Furnish:

1. The term "furnish" is used to mean "supply and deliver to project site, ready for unloading, unpacking, assemble, installation, and similar operations."
2. Where "furnish" applies to work for which the installation is not otherwise specified, "furnish" in such case shall mean "furnish and install."

I. Install: The term "install" is used to describe operations at project site including "unloading, unpacking, assembly, erection, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning and similar operation."

J. Provide: The term "provide" means "to furnish and install, complete and ready for intended use."

1.05 PERMITS, UTILITY CONNECTIONS AND INSPECTIONS:

A. General: Refer to DIVISION 01 for construction phasing and time increments.

B. Fees and Costs: If, during the course of the construction, a need arises to buy utilities, the Contractor shall pay all fees attendant thereto. If City or privately owned utility piping or electrical cable needs to be extended, relocated, or terminated, the Contractor will pay all permits and construction/inspection fees associated with that particular work.

C. All work performed on this project is under the authority of the local officials and local construction fees or construction permits will be required except as may be required for new service taps, or new or modified connections to City controlled services. If inspections by City personnel are specifically required by this document, then the Contractor is responsible for any fees or permits in connection to those requirements.

D. Compliance: The Contractor shall comply in every respect with all requirements of National Fire Protection Association, local Fire Department regulations and utility company requirements. In

no case does this relieve the Contractor of the responsibility of complying with these Specifications and Drawings where specified conditions are of higher quality than the requirements of the above-specified authorities. Where requirements of the Specifications and Drawings are more lenient than the requirements of the above authorities having jurisdiction, the Contractor shall make installations in compliance with the requirements of the above authorities with no extra compensation.

1.06 CONTRACT DOCUMENTS:

A. All dimensional information related to new structures shall be taken from the appropriate Drawings. All dimensional information related to existing facilities shall be taken from actual measurements made by the Contractor on the site.

B. The interrelation of the Specifications, the Drawings, and the schedules are as follows: The Specifications determine the nature and setting of the several materials, the Drawings establish the quantities, dimensions and details, and the schedules give the performance characteristics. If the Contractor requires additional clarification, he shall request it in writing, following the contractually prescribed information flow requirements.

C. Should the Drawings or Specifications conflict within themselves, or with each other, the better quality, or greater size or quantity of work or materials shall be performed or furnished.

1.07 ALLOWANCES

A. Cash Allowance: Refer to Division 01 of the Construction Documents for information and requirements.

1.08 ALTERNATES

A. Alternates quoted on Bid Forms will be reviewed and accepted or rejected at the Owner's option. Accepted Alternates will be identified in Owner-Contractor Agreement.

B. Coordinate related work and modify surrounding work as required.

C. Schedule of Alternates: See "Special Conditions" and Bid Form.

D. Any Alternate Proposals are summarized in Division 01 of the Specifications. The Contractor is directed to refer to all Sections of the Specifications and Drawings for this project to determine the exact extent and scope of the various Alternate Proposals as each pertains to the work of all trades.

1.09 SUBMITTALS

A. Refer to Uniform General Conditions.

B. Submit shop drawings and product data grouped to include complete submittals of related systems, products, and accessories in a single submittal.

C. Mark dimensions and values in units to match those specified.

D. Submit Fabrication Drawings whenever (1) equipment proposed varies in physical size and arrangement from that indicated on the Drawings, thus causing rearrangement of equipment space, (2) where tight spaces require extreme coordination between ductwork, piping, conduit, and other equipment, (3) where called for elsewhere in these Specifications; and (4) where specifically requested by the Architect/Engineer. Fabrication Drawings shall be made at no additional charge to the Owner or the Architect/Engineer.

E. All required Fabrication Drawings, except as noted otherwise, shall be prepared at a scale of not less than 1/4" = 1'-0". Fabrication Drawings for ductwork, air handling units, and sections in Mechanical Rooms shall be drawn at a minimum scale of 3/8" = 1'-0". Submit three blueline prints of each Fabrication Drawing to the Architect/Engineer for review. Reproduction and submittal of the Construction Documents is not acceptable. The Architect/Engineer will review the drawing and return one print with comments.

1.11 SUBSTITUTION OF MATERIALS AND EQUIPMENT:

A. Refer to General Conditions for substitution of materials and equipment.

B. General: Within thirty days after the date of contract award or work order, whichever is later, and before purchasing or starting installation of materials or equipment, the Contractor shall submit for review, a complete list of suppliers, contractors and manufacturers for all materials and equipment which will be submitted for incorporation into the project. The list shall be arranged in accordance with the organization of the Specifications. This initial list shall include the manufacturer's name and type or catalog number as required to identify the quality of material or equipment proposed. This list will be reviewed by the Engineer and the Owner and will be returned to the Contractor with comments as to which items are acceptable without further submittal data and which items will require detailed submittal data for further review and subsequent approval. The initial list shall be submitted as herein specified. Materials and equipment requiring detailed submittal data shall be submitted with sufficient data to indicate that all requirements of these Specifications have been met and samples shall be furnished when requested. All manufacturer's data used as part of the submittal shall have all inapplicable features crossed out or deleted in a manner that will clearly indicate exactly what is to be furnished.

C. It is not the intent of the Drawings and/or Specifications to limit products to any particular manufacturer nor to discriminate against an "APPROVED EQUAL" product as produced by another manufacturer. Some proprietary products are mentioned to set a definite standard for acceptance and to serve as a reference in comparison with other products. When a manufacturer's name appears in these Specifications, it is not to be construed that the manufacturer is unconditionally acceptable as a provider of equipment for this project. The successful manufacturer or supplier shall meet all of the provisions of the appropriate specification(s).

D. The specified products have been used in preparing the Drawings and Specifications and thus establish minimum qualities with which substitutes must at least equal to be considered acceptable. The burden of proof of equality rests with the Contractor. The decision of the designer is final.

E. When requested by the Architect/Engineer, the Contractor shall provide a sample of the proposed substitute item. In some cases, samples of both the specified item and the proposed item shall be provided for comparison purposes.

F. Timeliness: The burden of timeliness in the complete cycle of submittal data, shop Drawings, and sample processing is on the Contractor. The Contractor shall allow a minimum of six (6) weeks time frame for review of each submission by the office of the design discipline involved after receipt of such submissions by that design discipline. The Contractor is responsible for allowing sufficient time in the construction schedule to cover the aforementioned cycles of data processing, including time for all resubmittal cycles on unacceptable materials, equipment, etc. covered by the data submitted. Construction delays and/or lack of timeliness in the above regard are the responsibility of the Contractor and will not be considered in any request for scheduled construction time extensions and/or additional costs to the Owner.

G. All equipment installed on this project shall have local representation, local factory authorized service, and a local stock of repair parts.

H. Acceptance of materials and equipment will be based on manufacturer's published data and will be tentative subject to the submission of complete shop Drawings indicating compliance with the contract documents and that adequate and acceptable clearances for entry, servicing, and maintenance will exist. Acceptance of materials and equipment under this provision shall not be construed as authorizing any deviations from the Specifications, unless the attention of the Architect/Engineer has been directed in writing to the specific deviations. Data submitted shall not contain unrelated information unless all pertinent information is properly identified.

I. Certification: The Contractor shall carefully examine all data forwarded for approval and shall sign a certificate to the effect that the data has been carefully checked and found to be correct with respect to dimensions and available space and that the equipment complies with all requirements of the Specifications.

J. Physical Size of Equipment: Space is critical; therefore, equipment of larger sizes than shown, even though of specified manufacturer, will not be acceptable unless it can be demonstrated that ample space exists for proper installation, operation, and maintenance.

K. Materials and Equipment Lists: Eight (8) copies of the list of materials and equipment, the name of manufacturer, trade name, type, and catalog number shall be submitted to the Architect/Engineer. The lists shall be accompanied by eight (8) sets of pictorial and descriptive data derived from the manufacturers' catalogs, sales literature, or incorporated in the Shop Drawings.

L. Should a substitution be accepted, and should the substitute material prove defective, or otherwise unsatisfactory for the service intended within the guarantee period, this material or equipment shall be replaced with the material or equipment specified at no additional cost to the Owner.

1.12 MATERIALS AND WORKMANSHIP:

A. All materials, unless otherwise specified, shall be new, free from all defects, suitable for the intended use, and of the best quality of their respective kinds. Materials and equipment shall be installed in accordance with the manufacturer's recommendations and the best standard practice for the type of work involved. All work shall be executed by mechanics skilled in their respective trades, and the installations shall provide a neat, precise appearance. Materials and/or equipment damaged in shipment or otherwise damaged prior to installation shall not be repaired at the job site but shall be replaced with new materials and/or equipment.

B. The responsibility for the furnishing of the proper equipment and/or material and seeing that it is installed as intended by the manufacturer, rests entirely upon the Contractor who shall request advice and supervisory assistance from the representative of specific manufacturers during the installation.

1.13 FLAME SPREAD PROPERTIES OF MATERIALS:

A. Materials and adhesives incorporated in this project shall conform to NFPA Standard 255, "Method of Test of Surface Burning Characteristics of Building Materials" and NFPA 90. The classification shall not exceed a flame spread rating of 25 for all materials, adhesives, finishes, etc., specified for each system, and shall not exceed a smoke developed rating of 50.

1.14 REGULATORY REQUIREMENTS

A. The "Authority Having Jurisdiction" over the project described by these documents is the Owner, as an Agency of the State of New Mexico. As such, it is required that the installation shall meet the minimum standards prescribed in the latest editions of the following listed codes and standards, which are made a part of these Specifications. All referenced codes and standards shall be those current at the date of issue of the design documents.

B. National Fire Protection Association Standards (NFPA):

1. NFPA No. 13, Sprinkler System, Installation
2. NFPA No. 14, Standpipes and Hose Systems
3. NFPA No. 54, Gas Appliances, Piping, National Fuel Gas Code
4. NFPA No. 90A, Air Conditioning Systems

C. American Gas Association Publications (AGA): Directory of Approved Gas Appliances and Tested Accessories

D. American Society of Mechanical Engineers (ASME): Boiler and Pressure Vessel Codes

E. Air Conditioning and Refrigeration Institute Standards (ARI): All standards related to refrigeration and air conditioning equipment and piping furnished under these Specifications.

F. Sheet Metal and Air Conditioning Contractors National Association, Inc. (SMACNA): All current editions of applicable manuals and standards (See Sections 23 31 00.UT and 23 33 00.UT).

G. Air Moving and Conditioning Association (AMCA): All current editions of applicable manuals and standards.

H. American Society of Testing Materials (ASTM): All current editions of applicable manuals and standards.

I. American Water Works Association (AWWA): All current editions of applicable manuals and standards.

J. National Electrical Manufacturers' Association (NEMA): All current editions of applicable manuals and standards.

K. Uniform Plumbing Code – Current Edition

L. Uniform Mechanical Code – Current Edition

M. International Building Code

N. Occupational Safety and Health Act (OSHA)

P. ADA and ANSI Standards: Per Federal ADA requirements.

Q. Fire Marshal Regulations

R. State Energy Code

S. Refer to Specification Sections hereinafter bound for additional Codes and Standards.

T. All materials and workmanship shall comply with all applicable state and national codes, Specifications, and industry standards. In all cases where Underwriters' Laboratories, Inc. have established standards for a particular type material, such material shall comply with these standards. Evidence of compliance shall be the UL "label" or "listing" under Re-Examination Service.

U. The Contract Documents are intended to comply with the aforementioned rules and regulations; however, some discrepancies may occur. Where such discrepancies occur, the Contractor shall immediately notify the Architect/Engineer in writing of said discrepancies and apply for an interpretation. Should the discovery and notification occur after the execution of a contract, any additional work required for compliance with said regulations shall be paid for as covered by Division 01 of these Contract Documents, providing no work of fabrication of materials has been accomplished in a manner of noncompliance. Should the Contractor fabricate and/or install materials and/or workmanship in such a manner that does not comply with the applicable codes, rules and regulations, the Contractor who performed such work shall bear all costs arising in correcting these deficiencies to comply with said rules and regulations.

1.15 GENERAL MATERIALS AND EQUIPMENT REQUIREMENTS:

A. Storage at Site: The Contractor shall not receive material or equipment at the job site until there is suitable space provided to properly protect equipment from rust, drip, humidity, and dust damage.

B. Capacities shall be not less than those indicated but shall be such that no component or system becomes inoperative or is damaged because of startup or other overload conditions.

C. Conformance with Agency Requirements: Where materials or equipment are specified to be approved, listed, tested, or labeled by the Underwriters' Laboratories, Inc., or constructed and/or tested in accordance with the standards of the American Society of Mechanical Engineers or the Air Moving and Conditioning Association, the Contractor shall submit proof that the items furnished under this Section of the Specifications conform to such requirements. The label of the Underwriters Laboratories, Inc., applied to the item will be acceptable as sufficient evidence that the items conform to such requirements. The ASME stamp or the AMCA label will be acceptable as sufficient evidence that the items conform to the respective requirements.

D. Nameplates: Each major component of equipment shall have the manufacturer's name, address, and catalog number on a plate securely attached to the item of equipment. All data on nameplates shall be legible at the time of Final Inspection.

E. Prevention of Rust: Standard factory finish will be acceptable on equipment specified by model number; otherwise, surfaces of ferrous metal shall be given a rust inhibiting coating. The treatment shall withstand 200 hours in salt spray fog test, in accordance with Method 6061 of Federal Standard No. 141. Immediately after completion of the test, the specimen shall show

no signs of wrinkling or cracking and no signs of rust creepage beyond 1/8" on either side of the scratch mark. Where rust inhibitor coating is specified hereinafter, any treatment that will pass the above test is acceptable unless a specific coating is specified except that coal tar or asphalt type coating will not be acceptable unless so stated for a specific item. Where steel is specified to be hot-dip galvanized, mill-galvanized sheet steel may be used provided all raw edges are painted with a zinc-pigmented paint conforming to Military Specification MIL-P-26915.

F. Protection from Moving Parts: Belts, pulleys, chains, gears, couplings, projecting set screws, keys, and other rotating parts shall be fully enclosed or properly guarded for personnel protection.

G. Verification of Dimensions: The Contractor shall be responsible for the coordination and proper relation of his work to the building structure and to the work of all trades. The Contractor shall visit the premises and become thoroughly familiar with all details of the work and working conditions, to verify all dimensions in the field, and to advise the Architect/Engineer of any discrepancy before performing any work. Adjustments to the work required in order to facilitate a coordinated installation shall be made at no additional cost to the Owner or the Architect/Engineer.

1.16 PROJECT/SITE CONDITIONS

A. Install Work in locations shown on Drawings, unless prevented by Project conditions.

B. Prepare drawings showing proposed rearrangement of Work to meet Project conditions, including changes to Work specified in other Sections. Obtain permission of [Owner] [Architect/Engineer] before proceeding.

1.17 MANUFACTURER'S RECOMMENDATIONS

A. The manufacturer's published directions shall be followed in the delivery, storage, protection, installation, piping, and wiring of all equipment and material. The Contractor shall promptly notify the Architect/Engineer, in writing, of any conflict between the requirements of the Contract Documents and the manufacturers' directions, and shall obtain the Architect/Engineer's instructions before proceeding with the work. Should the Contractor perform any such work that does not comply with the manufacturers' directions or such instructions from the Architect/Engineer, he shall bear all costs arising in connection with the deficiencies.

1.18 SPACE AND EQUIPMENT ARRANGEMENT:

A. The size of mechanical and electrical equipment indicated on the Drawings is based on the dimensions of a particular manufacturer. While other manufacturers may be acceptable, it is the responsibility of the Contractor to determine if the equipment he proposes to furnish will fit in the space. Fabrication Drawings shall be prepared when required by the Architect/Engineer or Owner to indicate a suitable arrangement.

B. All equipment shall be installed in a manner to permit access to all surfaces. All valves, motors, drives, filters, and other accessory items shall be installed in a position to allow removal for service without disassembly of another part.

1.19 LARGE APPARATUS:

A. Any large piece of apparatus which is to be installed in any space in the building, and which is too large to permit access through stairways, doorways, or shafts shall be brought to the job and placed in the space before the enclosing structure is completed. Following placement in the space, such apparatus shall be thoroughly, completely protected from damage as hereinafter specified.

1.20 PROTECTION:

A. The Contractor shall at all times take such precautions as may be necessary to properly protect all materials and equipment from damage from the time of delivery until the completion of the work. This shall include the erection of all required temporary shelters and supports to adequately protect any items stored in the open on the site from the weather, the ground and surrounding work; the cribbing of any items above the floor of the construction; and the covering of items in the incomplete building with tarpaulins or other protective covering; the installation of

electric heaters in electrical switchgear and similar equipment to prevent moisture damage. Failure on the part of the Contractor to comply with the above will be sufficient cause for the rejection of the items in question.

B. Take particular care not to damage the building structure in performing work. All finished floors, step treads, and finished surfaces shall be covered to prevent any damage by workmen or their tools and equipment during the construction of the building.

C. Equipment and materials shall be protected from rust both before and after installation. Any equipment or materials found in a rusty condition at the time of final inspection must be cleaned of rust and repainted as specified elsewhere in these Specifications.

1.21 COOPERATION BETWEEN TRADES AND WITH OTHER CONTRACTORS:

A. Each trade, subcontractor, and/or Contractor must work in harmony with the various other trades, subcontractors and/or Contractors on the job as may be required to facilitate the progress to the best advantage of the job as a whole. Each trade, subcontractor, and/or Contractor must pursue its work promptly and carefully so as not to delay the general progress of the job. This Contractor shall work in harmony with Contractors working under other contracts on the premises.

1.22 ELECTRICAL WIRING OF MOTORS AND EQUIPMENT:

A. The Contractor shall note that the electrical design and Drawings are based on the equipment scheduled and indicated on the Drawings, and should any mechanical equipment be provided requiring changes to the electrical design, the required electrical changes shall be made at no cost to the Owner.

B. The Electrical Trades shall provide all interconnecting wiring for the installation of all power. The Electrical Trades shall provide all disconnect switches as required for proper operation, as indicated on the Drawings or required by applicable code. All combination starters, individual starters, and other motor starting apparatus not specifically scheduled or specified as provided by the equipment manufacturer under the scope of Division 23, shall be provided under the scope of Division 26.

C. The Mechanical Trades shall provide complete wiring diagrams indicating power wiring and interlock wiring. Diagrams shall be submitted to the Architect/Engineer for review within thirty (30) days after the submittals for equipment have been reviewed. Diagrams shall be based on accepted equipment and shall be complete full phase and interlock control Drawings, not a series of manufacturer's individual diagrams. After these diagrams have been reviewed by the Architect/Engineer, copies shall be transmitted to the Electrical Trades by the Contractor. They shall be followed in detail. See Section 15E, TEMPERATURE CONTROLS, for additional clarification.

1.23 SUPERVISION:

A. Each Contractor and subcontractor shall keep a competent superintendent or foreman on the job at all times. (Refer to the Uniform General Conditions for additional information concerning supervision.)

B. It shall be the responsibility of each superintendent to study all Drawings and familiarize himself with the work to be done by other trades. He shall coordinate his work with other trades and before material is fabricated or installed, make sure that his work will not cause an interference with another trade. Where interferences are encountered, they shall be resolved at the job site by the superintendents involved. Where interferences cannot be resolved without major changes to the Drawings, the matter shall be referred to the A/E for ruling.

1.24 SITE OBSERVATION:

A. Site observation by the Architect/Engineer is for the express purpose of verifying compliance by the Contractor with the Contract Documents, and shall not be construed as construction supervision nor indication of approval of the manner or location in which the work is being performed as being a safe practice or place.

1.25 PRECEDENCE OF MATERIALS

A. The specifications determine the nature and setting of materials and equipment. The drawings establish quantities, dimensions and details.

B. The installation precedence of materials shall be as follows. Note that if an interference is encountered, this shall guide the contractor in the determination of which trade shall be given the "Right-of-Way".

Building lines

Structural Members

Soil and Drain Piping

Condensate Drains

Vent Piping

Supply, Return, and Outside Air Ductwork

Exhaust Ductwork

HVAC Water and Steam Piping

Steam Condensate Piping

Fire Protection Piping

Natural Gas Piping

Domestic Water (Cold and Hot)

Refrigerant Piping

Electrical Conduit

1.26 CONNECTIONS FOR OTHERS:

A. The Mechanical Contractor shall rough in for and make all gas, water, steam, sewer, etc. connections to all fixtures, equipment, machinery, etc., provided by others in accordance with detailed roughing-in Drawings provided by the equipment suppliers, by actual measurements of the equipment connections, or as detailed.

B. After the equipment is set in place, this Contractor shall make all final connections and shall provide all required pipe, fittings, valves, traps, etc.

C. Provide all air gap fittings required, using materials hereinbefore specified. In each service line connected to an item of equipment or piece of machinery, provide a shutoff valve. On each drain not provided with a trap, provide a suitable trap.

D. All pipe fittings, valves, traps, etc., exposed in finished areas and connected to chrome plated lines provided by others shall be chrome plated to match.

E. Provide all sheet metal ductwork, transition pieces, etc., required for a complete installation of vent hoods, fume hoods, etc., provided by others.

1.27 INSTALLATION METHODS:

A. Where to Conceal: All pipes, conduits, etc., shall be concealed in pipe chases, walls, furred spaces, or above the ceilings of the building unless otherwise indicated.

B. Where to Expose: In mechanical rooms, janitor's closets tight against pan soffits in exposed "Tee" structures, or storage spaces, but only where necessary, piping may be run exposed. All exposed piping shall be run in the most aesthetic, inconspicuous manner, and parallel or perpendicular to the building lines.

C. Support: All piping, ducts and conduits shall be adequately and properly supported from the building structure by means of hanger rods or clamps to walls as herein specified.

D. Maintaining Clearance: Where limited space is available above the ceilings below concrete beams or other deep projections, pipe and conduit shall be sleeved through the projection where it crosses, rather than hung below them in a manner to provide maximum above-floor clearance. Sleeves shall be as herein specified. Approval shall be obtained from the Architect/Engineer for each penetration.

E. All pipe, conduits, etc., shall be cut accurately to measurements established at the building and shall be worked into place without springing or forcing. All ducts, pipes and conduits run exposed in machinery and equipment rooms shall be installed parallel to the building lines, except that piping shall be sloped to obtain the proper pitch. Piping, ducts and conduits run in furred ceilings, etc., shall be similarly installed, except as otherwise shown. Conduits in furred ceilings and in other concealed spaces shall be neatly grouped and racked indicating good workmanship. All conduit and pipe openings shall be kept closed until the systems are closed with final connections.

1. All piping not directly buried in the ground shall be considered as "interior piping".
2. Prior to the installation of any ceiling material, gypsum, plaster, or acoustical board, the Contractor shall notify the construction inspector so that arrangement can be made for an inspection of the above-ceiling area about to be "sealed" off. The Contractor shall give as much advance notice as possible no less than 10 working days.
3. All above-ceiling areas will be subject to a formal inspection before ceiling panels are installed, or installation is otherwise concealed from view. All mechanical and electrical work at and above the ceiling, including items supported by the ceiling grid, such as air inlets or outlets and lighting fixtures, shall be complete and installed in accordance with contract requirements, including power to lighting fixtures, fans, and other powered items. Adequate lighting shall be provided to permit thorough inspection of all above-ceiling items. The inspection will include representatives of the following: General Contractor and each Subcontractor having work above the ceiling, Architect/Engineer, Physical Plant, Resident Construction Manager's Construction Inspector(s), the Resident Construction Manager and Office of Facilities Planning and Construction (OFPC). Areas to be included and time of inspection shall be coordinated with the Construction Inspector.
4. The purpose of this inspection is to verify the completeness and quality of the installation of the air conditioning systems, the electrical systems, the plumbing systems, and any other special above ceiling systems such as pneumatic tube, vacuum systems, fire sprinkler piping and cable tray systems. The ceiling supports (tee bar or lath) shall be in place so that access panel and light fixture locations are identifiable and so that clearances and access provisions may be evaluated.
5. No ceiling materials may be installed until the resulting deficiency list from this inspection is worked off and the Construction Inspector has given approval.

1.28 RECORDS FOR OWNER:

A. The Contractor shall maintain a set of "blueline" prints in the Field Office for the sole purpose of recording "installed" conditions. Daily note all changes made in these Drawings in connection with the final installation including exact dimensioned locations of all new underground utilities, services and systems and all uncovered existing active and inactive piping outside the building.

B. At Contract completion the Contractor shall provide a set of reproducible photographic mylar drawings, plus the photo negatives of the revised drawings. The contractor shall transfer the information from the "blueline" prints maintained as described above, and turn over this neatly marked set of reproducible Drawings representing the "as installed" work to the Architect/Engineers for verification and subsequent transmittal to the Owner. The Contractor shall refer to Division 01 of these Specifications, and to the Uniform General Conditions, for additional information. These Drawings shall include as a minimum:

1. Addendum written drawing changes.
2. Addendum supplementary drawings.
3. Accurate, dimensioned locations of all underground utilities, services and systems.
4. Identification of equipment work shown on Alternates as to whether alternates were accepted and work actually installed.

5. Change Order written drawing changes.
6. Change Order supplementary drawings.

C. Electronic Media:

1. In lieu of the drawings described above in 1.33B, the contractor shall submit one set of blueline prints, one set of vellum reproducables, and one set of discs containing all the drawings in AUTOCAD 2008 format.

D. "As installed" mylars shall bear a stamp, "stick on decal", or lettered title block generally located in lower right hand corner of Drawing entitled "AS INSTALLED DRAWING" with Company name of the installing trade Subcontractor and with a place for the date and the name of the responsible company representative.

E. In addition to the above, the Contractor shall accumulate during the progress of the job the following data, in duplicate, prepared in a neat brochure or packet folder and turn over to the Architect/Engineer for review, and subsequent delivery to the Owner.

1. All warranties and guarantees and manufacturers' directions on equipment and material covered by the Contract.
2. Two sets of operating instructions for heating and cooling and other mechanical and electrical systems. Operating instructions shall also include recommended preventative maintenance and seasonal changeover procedures.
3. Valve tag charts and diagrams specified herein.
4. Approved wiring diagrams and control diagrams representing "as installed" conditions.
5. Copies of approved Shop Drawings.
6. Any and all other data and/or drawings required as submittals during construction.
7. Repair parts list of all major items and equipment including name, address and telephone number of local supplier or agent.

F. All of the above data shall be submitted to the Architect/Engineer for approval, and shall be corrected as instructed by the Architect/Engineer prior to submission of the final request for payment.

1.29 CUTTING AND PATCHING:

A. General: Cut and patch walls, floors, etc., resulting from work in existing construction or by failure to provide proper openings or recesses in new construction.

B. Methods of cutting: Openings cut through concrete and masonry shall be made with masonry saws and/or core drills and at such locations acceptable to the Architect/Engineer. Impact-type equipment shall not be used except where specifically acceptable to the Architect/Engineer. Openings in precast concrete slabs for pipes, conduits, outlet boxes, etc., shall be core drilled to exact size.

C. Restoration: All openings shall be restored to "as-new" condition under the appropriate Specification Section for the materials involved, and shall match remaining surrounding materials and/or finishes.

D. Masonry: Where openings are cut through masonry walls, provide and install lintels or other structural supports to protect the remaining masonry. Adequate supports shall be provided during the cutting operation to prevent any damage to the masonry occasioned by the operation. All structural members, supports, etc., shall be of the proper size and shape, and shall be installed in a manner acceptable to the Architect/Engineer.

E. Plaster: All mechanical work in areas containing plaster shall be completed prior to the application of the finish plaster coat. Cutting of finish plaster coat will not be permitted.

F. Special Note: No cutting, boring, or excavating which will weaken the structure shall be undertaken.

1.30 ROOF PENETRATIONS AND FLASHING:

A. Pipe, conduit and duct sleeves, pitch pockets, and flashings compatible with the roofing installation shall be provided and installed by a qualified contractor for all roof penetrations. This shall be the responsibility of the General Contractor.

1.31 EXCAVATION, TRENCHING AND BACKFILL:

A. Excavation (See Divisions 00 and 01 for special requirements related to excavation and trenching.):

1. The Mechanical and Electrical subcontractors shall perform all excavations of every description, for their particular installations and of whatever substances encountered, to the depths indicated on the Drawings and/or required for the installation of piping, conduit, utility systems, etc. All exterior lines shall be installed with a minimum cover of 24", unless otherwise indicated. Generally, more cover shall be provided if grade will permit. All excavation materials not required for backfill or fill shall be removed and wasted as acceptable to the Construction Inspector. All excavations shall be made only by open cut. The banks of trenches shall be kept as nearly vertical as possible and where required, shall be properly sheeted and braced. Trenches shall be not less than 12" wider nor more than 16" wider than the outside edges of the pipe to be laid therein, and shall be excavated true to line so that a clear space not less than 6" nor more than 8" in width is provided on each side of the pipe. For sewers, the maximum width of trench specified applies to the width at and below the level may be made as wide as necessary for sheeting and bracing, and the proper installation of the work.

2. The bottom of trenches shall be accurately graded to provide proper fall and uniform bearing and support for each section of the pipe on undisturbed soil or 2" of sand fill at every point along its entire length, except for portions of the pipe sections where it is necessary to excavate for bell holes and for the proper sealing of pipe joints. Bell holes shall be dug after the trench bottom has been graded. Where inverts are not shown, grading shall be determined by the National Plumbing Code for the service intended and the size used. Bell holes for lead pipe joints shall be 12" in depth below the trench bottom and shall extend from a point 6" back of the face of the bell. Such bell holes shall be of sufficient width to provide ample room for caulking. Bell holes for sewer tile and water pipe shall be excavated only to an extent sufficient to permit accurate work in the making of the joints and to insure that the pipe, for a maximum of its length, will rest upon the prepared bottom of the trench. Depressions for joints other than bell-and-spigot shall be made in accordance with the recommendations of the joint manufacturer for the particular type of joint used. In general, grading for electrical ductbanks and conduits shall be from building to manhole, and from a high point between manholes to each manhole. Special pipe beds shall be provided as specified hereinafter.

3. The lower 4" of the pipe trenches measuring from an overhead line set parallel to the grade line of the sewer shall be excavated only a few feet in advance to the pipe laying, by men especially skilled in this type of work. Where damage is likely to result from withdrawing sheeting, the sheeting shall be left in place. Except at locations where excavation of rock from the bottom of trenches is required, care shall be taken not to excavate below the depths required. Where rock excavation is required, the rock shall be excavated to a minimum overdepth of 6" below the trench depths specified. The overdepth rock excavation and all excess trench excavation shall be backfilled with sand. Whenever wet or otherwise unstable soil is incapable of properly supporting the pipe is encountered in the trench bottom, such soil shall be removed to a depth and for the trench lengths required, and then backfilled to trench bottom grade, as hereinafter specified, with sand.

4. All grading in the vicinity of excavation shall be controlled to prevent surface ground water from flowing into the excavations. Any water accumulated in the excavations shall be removed by pumping or other acceptable method. During excavation, material suitable for backfilling shall be stacked in an orderly manner a sufficient

distance back from edges of trenches to avoid overloading and prevent slides or cave-ins. Material unsuitable for backfilling shall be wasted and removed from the job site as directed by the Construction Inspector.

5. All shoring and sheeting required to perform and protect the excavations and to safeguard employees and/or adjacent structures shall be provided.

6. Excavate as required under the building in order that all piping, ductwork, etc., shall clear the ground a minimum of 12" for a distance of 24" on either side. Edges of such excavations shall slope at an angle of not over 45 degrees with the horizontal unless otherwise approved by the Construction Inspector. The bottom of such excavation shall be graded to drain in a manner acceptable to the Construction Inspector.

7. Trenches for cast iron drain, storm water and sewer lines inside the building shall be properly excavated, following, in general, the procedures set out for exterior lines. Where floors are to be poured over these lines, they shall be backfilled, tamped and settled with water. Where no flooring is to cover the lines, they shall be backfilled to form a level grade.

8. All surplus materials removed in these trenching operations becomes the property of the contractor, and shall be disposed of at the expense of the contractor, at a legal disposal site, off of the campus.

B. Backfilling:

1. Trenches shall not be backfilled until all required tests are performed and until the piping, utilities systems, etc., as installed are certified by the Owner's inspector to conform to the requirements specified hereinafter. The trenches shall be carefully backfilled with sand to a depth of 12 inches above the top of the pipe. The next layer and subsequent layers of backfill may be excavated materials approved for backfilling, consisting of earth, loam, sandy clay, sand and gravel, soft shale, or other approved materials free from large clods of earth or stones larger than 1 1/2" in diameter, flooded until the pipe has cover of not less than one foot. The remainder of the backfill material shall then be thrown into the trenches, moistened, and tamped or flooded in one foot layers. Blasted rock, broken concrete or pavement, and large boulders shall not be used as backfill material. Any trenches improperly backfilled, or where settlement occurs, shall be reopened to the depth required for proper compaction, then refilled and mounded over, and smoothed off.

2. Backfill under concrete slabs-on-fill shall be as specified above, shall be gravel, or shall be other such materials more suitable for the application. Installation and compaction shall be as required for compatibility with adjacent materials.

C. Opening and Reclosing Pavement and Lawns: Where excavation requires the opening of existing walks, streets, drives, other existing pavement, or lawns, such surfaces shall be cut as required to install new lines and to make new connections to existing lines. The sizes of the cut shall be held to a minimum, consistent with the work to be accomplished. After the installation of the new work is completed and the excavation has been backfilled and flooded, the area shall be patched, using materials to match those cut out. The patches shall thoroughly bond with the original surfaces and shall be level with them, and shall meet all the requirements established by the authorities having jurisdiction over such areas.

D. Excavation in Vicinity of Trees: All trees including low hanging limbs within the immediate area of construction shall be adequately protected to a height of at least 5 ft. to prevent damage from the construction operations and/or equipment. All excavation within the outermost limb radius of all trees shall be accomplished with extreme care. All roots located within this outermost limb radius shall be brought to the attention of the Construction Inspector before they are cut or damaged in any way. The Construction Inspector will give immediate instructions for the disposition of same. All stumps and roots encountered in the excavation, which are not within the outermost limb radius of existing trees, shall be cut back to a distance of not less than 18" from the outside of any concrete structure or pipeline. No chips, parts of stumps, or loose rock

shall be left in the excavation. Where stumps and roots have been cut out of the excavation, clean compacted dry bank sand shall be backfilled and tamped.

1.32 ACCESS DOORS:

A. General: This Contractor shall provide wall or ceiling access doors for unrestricted access to all concealed items of mechanical equipment or devices.

B. Doors: Access doors mounted in painted surfaces shall be of Milcor (Inland-Ryerson Construction Products Company) manufacture, Style K for plastered surfaces and Style M or DW for non-plastered surfaces. The Style K doors shall be set so that the finished surface of the door is even with the finished surface of the adjacent finishes. Access doors mounted on tile surfaces shall be of similar construction as noted above, except they shall be of stainless steel materials. Access doors shall be a minimum of 12" x 12" in size.

1.33 OPERATION PRIOR TO COMPLETION:

A. When any piece of mechanical equipment is operable and it is to the advantage of the Contractor to operate the equipment, he may do so, providing that he properly supervises the operation, and has the Construction Inspector's written permission to do so. The warranty period shall, however, not commence until such time as the equipment is operated for the beneficial use of the Owner, or date of substantial completion, whichever occurs first.

B. Regardless of whether or not the equipment has or has not been operated, the Contractor shall properly clean the equipment, install clean filter media, properly adjust, and complete all deficiency list items before final acceptance by the Owner. The date of acceptance and performance certification will be the same date.

1.34 CHECKING AND TESTING MATERIALS AND/OR EQUIPMENT:

A. Before the work is accepted, an authorized representative of the manufacturer of the installed materials and/or equipment shall personally inspect the installation and operation of his materials and/or equipment to determine that it is properly installed and in proper operating order. The qualifications of the representative shall be appropriate to the technical requirements of the installation. The qualifications of the representative shall be submitted to the owner for approval. The decision of the owner concerning the appropriateness of the representative shall be final. Testing and checking shall be accomplished during the course of the work where required by work being concealed, and at the completion of the work otherwise. In addition, the Contractor shall submit to the Architect/Engineer a signed statement from each representative certifying as follows: "I certify that the materials and/or equipment listed below have been personally inspected by the undersigned authorized manufacturer's representative and is properly installed and operating in accordance with the manufacturer's recommendations".

B. Check inspections shall include plumbing equipment, heating, air conditioning, insulation, ventilating equipment, controls, mechanical equipment and such other items hereinafter specified or specifically designated by the Architect/Engineer.

1.37 TESTS:

A. The Contractor shall make, at no additional cost to the Owner, any tests deemed necessary by the inspection departments having jurisdiction, and in the National Fire Protection Association, ASTM, etc. Standards listed. The Contractor shall provide all equipment, materials, and labor for making such tests. Reasonable amounts of fuel and electrical energy costs for system tests will be paid by the Owner. Fuel and electrical energy costs for system adjustment and tests which follow beneficial occupancy by the Owner will be borne by the Owner.

B. Additional tests specified hereinafter under the various Specification Sections shall be made.

C. The Construction Inspector shall be notified in writing at least 10 working days prior to each test and other Specification requirements requiring action on the part of the Construction Inspector. All equipment shall be placed in operation and tested for proper automatic control requirements before the balancing agency starts their work.

D. Maintain Log of Tests as hereinafter specified.

E. See Specifications hereinafter for additional tests and requirements.

1.38 LOG OF TESTS:

A. All tests shall have pertinent data logged by the Contractor at the time of testing. Data shall include date, time, personnel, description, and extent of system tested, test conditions, test results, specified results, and other pertinent data. Data shall be delivered to the Architect/Engineer as specified under "Requirements for Final Acceptance". All Test Log entries shall be legibly signed by the Project Contractor or his authorized job superintendent.

1.39 COOPERATION AND CLEANUP:

A. It shall be the responsibility of each trade to cooperate fully with the other trades on the job to help keep the job site in a clean and safe condition. At the end of each day's work, each trade shall properly store all of his tools, equipment and materials and shall clean his debris from the job. Upon the completion of the job, each trade shall immediately remove all of his tools, equipment, any surplus materials and all debris caused by that portion of the work.

1.40 CLEANING AND PAINTING:

A. All equipment, piping, conduit, ductwork, grilles, insulation, etc., furnished and installed in exposed areas under Divisions 23 and 26 of these Specifications and as hereinafter specified shall be cleaned, prepared, and painted according to the following specification. In the event of a conflict between the specifications referenced, the provisions of this specification shall prevail only for Division 23 and Division 26 work.

B. All purchased equipment furnished by the mechanical and electrical subcontractors shall be delivered to the job with a suitable factory protective finish with the colors hereinafter specified. The following materials shall not be painted: copper, galvanized metal, stainless steel, fiberglass, PVC, and PVDF.

C. Before painting, materials and equipment surfaces shall be thoroughly cleaned of cement, plaster, and other foreign materials, and all oil and grease spots shall be removed. Such surfaces shall be carefully wiped and all cracks and corners scraped out. Exposed metal work shall be carefully brushed down with the steel brushes to remove rust and other spots and left smooth and clean.

D. Color of finish painting in Mechanical Rooms shall be painted in accordance with the following outline table. For painting purposes, the equipment and piping inside of built-up air handling units shall be painted the same as if they were within the walls of a Mechanical Room. Two coats shall be applied with a light tint first coat and deep color for final coat. Colors shall be as follows:

ITEM	COLOR	"P and L" PAINT NUMBER
Equipment Bases	Light Green	YG493M (Winter Pear)
Equipment	Green	YG511Y (Biscay Green)
Piping (Insulated and Uninsulated)	Light Gray	B798M (London Fog)
Hanger Rods	Same as "Piping" above	
Steam Traps and Metal Exposed to High Temperatures	Same as "Piping" above, high temp rated	
Atmospheric Relief Line	Same as "Piping" above	
Ductwork, AHU, Fans and Insulation	Buff	Y354M (Tawny Gold)
Valve Hand Wheels	Blu	B726M (Siam Blue)
Pump Couplings and Fuel Gas Piping (including natural gas, LPG, etc.)	Safety Yellow	Y361M (Daisy Yellow)
Fire Protection Equipment and Piping	Safety Red	R131R (Vibrant Red)

PART 2 PRODUCTS

2.01 Year 2000 Performance Warranty

For purposes of this warranty, the following definitions shall apply:

A. "Accurately" shall be defined to include:

1. Calculations correctly performed using four digit year processing;
2. Functionality on-line, batch, including but not limited to, entry, inquiry, maintenance and updates support four digit year processing;
3. Interfaces and reports must support four digit year processing;
4. Successful translation into year 2000 with valid date (e.g. CC/YY/MM/DD) without human intervention. Additional representations for week, hour, minute and second, if required, complies with the international standard ISO 8601:1988, "Data elements and interchange formats - Information exchange Representation of dates and time." When ordinal dates are used, the ISO standard format CCYYDDD is used;
5. Processing with four digit year after transition to any date beyond the year 2000 without human intervention;
6. Correct results in forward and backward date calculations spanning century boundaries;
7. Correct leap year calculations; and
8. Correct forward and backward date calculations spanning century boundaries, including conversion of previous years stored, recorded or entered as two digits.

B. "Date integrity" shall mean all manipulations of time-related data (dates, durations, days of week, etc.) will produce desired results for all valid date values within the application domain.

C. "Explicit century" shall mean date elements in interfaces and data storage permit specifying century to eliminate date ambiguity.

D. "Extraordinary actions" shall be defined to mean any action outside the normal documented processing steps identified in the product's reference documentation.

E. "General integrity" shall mean no value for current date will cause interruptions in desired operation- especially from the 20th to 21st centuries.

F. "Implicit century" shall mean for any data element without century, the correct century is unambiguous for all manipulations involving that element.

G. "Product" or "products" shall be defined to include, but is not limited to, any supplied or supported hardware, software, firmware and/or micro code.

H. "Valid date" shall be defined as a date containing a four digit year, a two digit month and a two digit day., or the ISO 8601:1988, Data elements - Information Exchange - Representation of dates and times". When ordinal dates are used, ISO standard format of CCYYDDD is used.

I. The contractor warrants that product(s) delivered and installed under this contract shall be able to accurately process valid date data when used in accordance with the product documentation provided by the contractor and require no extraordinary actions on the part of the Owner or its personnel. Products under this Contract possess general integrity, date integrity, explicit and implicit century capabilities. If the Contract requires that specific products must perform as a system in accordance with the foregoing warranty, then the warranty shall apply to those listed products as a system. The duration of this warranty and the remedies available the Owner for breach of this warranty shall be as defined in, and subject to, the terms and conditions contained in this Contract; provided, that notwithstanding any provision to the contrary in such commercial warranty or warranties, the remedies available to the Owner under this warranty shall include repair or replacement of any supplied product whose non-compliance is discovered and made known to the contractor in writing within one year after final acceptance, as that term is defined elsewhere in the contract. Nothing in this warranty shall be considered to limit any rights or remedies the Owner may otherwise have under this contract with respect to defects other than Year 2000 performance.

J. Prior to final acceptance the Owner may require demonstration of correct system operation without manual intervention before and after roll over between the following dates:

Dec 31, 1998 - Jan 1, 1999 Tests for use of 9's as control code errors

Sep 9, 1999 - Sep 10, 1999 "

Dec 31, 1999- Jan 1, 2000 Tests century digits rollover

Feb 28, 2000 - Feb 29, 2000 Tests recognition of leap year

Feb 29, 2000 - Mar 1, 2000 "

Mar 31, 2000 - Apr 1, 2000 "

Apr 30, 2000 - May 1, 2000 "

Dec 31, 2000 - Jan 1, 2001 Tests millennium rollover

Feb 28, 2001 - Mar 1, 2001 Tests recognition of no leap year

Dec 31, 2009 - Jan 1, 2010 Tests normal decade rollover

Dec 31, 2027 - Jan 1, 2028 ”

PART 3 - EXECUTION

3.01 PIPE PRESSURE TESTS:

A. The following lines shall be tested 1.5 times working pressure or at least at the following stated pressure for the length of time noted or as required by local codes:

Testing Service	Testing Medium	Pressure (PSIG)	Time in Hours
Domestic Hot & Cold Water	Water	150	24
Sanitary & Storm Piping	Water	Fill to top	24

Natural Gas	Air	100	24
Fire Protection Systems	Water	150	24

B. Where leaks occur, the pipe shall be repaired and the tests repeated. No leaks shall be corrected by peening. Defective piping and joints shall be removed and replaced.

END OF SECTION 23 0000

SECTION 23 0529

HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

All suspended piping and equipment shall be supported from the structure. Hangers and supports shall not be suspended from roof deck.

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. This Section includes the following hangers and supports for HVAC system piping and equipment:

1. Steel pipe hangers and supports.
2. Trapeze pipe hangers.
3. Metal framing systems.
4. Thermal-hanger shield inserts.
5. Fastener systems.
6. Pipe stands.
7. Equipment supports.

1.03 DEFINITIONS

A. MSS: Manufacturers Standardization Society for The Valve and Fittings Industry Inc.

B. Terminology: As defined in MSS SP-90, "Guidelines on Terminology for Pipe Hangers and Supports."

1.04 PERFORMANCE REQUIREMENTS

A. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.

B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

C. Design seismic-restraint hangers and supports for piping and equipment.

1.05 SUBMITTALS

A. Product Data: For the following:

1. Steel pipe hangers and supports.
2. Fiberglass pipe hangers.
3. Thermal-hanger shield inserts.
4. Powder-actuated fastener systems.

B. Shop Drawings: Show fabrication and installation details and include calculations for the following:

1. Trapeze pipe hangers. Include Product Data for components.
2. Metal framing systems. Include Product Data for components.
3. Fiberglass strut systems. Include Product Data for components.
4. Pipe stands. Include Product Data for components.
5. Equipment supports.

C. Welding certificates.

1.06 QUALITY ASSURANCE

A. Welding: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code--Steel."

B. Welding: Qualify procedures and personnel according to the following:

1. AWS D1.1, "Structural Welding Code--Steel."

2. AWS D1.2, "Structural Welding Code--Aluminum."
3. AWS D1.3, "Structural Welding Code--Sheet Steel."
4. AWS D1.4, "Structural Welding Code--Reinforcing Steel."
5. ASME Boiler and Pressure Vessel Code: Section IX.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.
2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.02 STEEL PIPE HANGERS AND SUPPORTS

A. Description: MSS SP-58, Types 1 through 58, factory-fabricated components. Refer to Part 3 "Hanger and Support Applications" Article for where to use specific hanger and support types.

B. Manufacturers:

1. AAA Technology & Specialties Co., Inc.
2. Bergen-Power Pipe Supports.
3. B-Line Systems, Inc.; a division of Cooper Industries.
4. Carpenter & Paterson, Inc.
5. Empire Industries, Inc.
6. ERICO/Michigan Hanger Co.
7. Globe Pipe Hanger Products, Inc.
8. Grinnell Corp.
9. GS Metals Corp.
10. National Pipe Hanger Corporation.
11. PHD Manufacturing, Inc.
12. PHS Industries, Inc.
13. Piping Technology & Products, Inc.
14. Tolco Inc.

C. Galvanized, Metallic Coatings: Pregalvanized or hot dipped.

D. Nonmetallic Coatings: Plastic coating, jacket, or liner.

E. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion for support of bearing surface of piping.

2.03 TRAPEZE PIPE HANGERS

A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural-steel shapes with MSS SP-58 hanger rods, nuts, saddles, and U-bolts.

2.04 METAL FRAMING SYSTEMS

A. Description: MFMA-3, shop- or field-fabricated pipe-support assembly made of steel channels and other components.

B. Manufacturers:

1. B-Line Systems, Inc.; a division of Cooper Industries.
2. ERICO/Michigan Hanger Co.; ERISTRUT Div.
3. GS Metals Corp.
4. Power-Strut Div.; Tyco International, Ltd.

5. Thomas & Betts Corporation.
6. Tolco Inc.
7. Unistrut Corp.; Tyco International, Ltd.

C. Coatings: Manufacturer's standard finish, unless bare metal surfaces are indicated.

D. Nonmetallic Coatings: Plastic coating, jacket, or liner.

2.05 THERMAL-HANGER SHIELD INSERTS

A. Description: 100-psig-minimum, compressive-strength insulation insert encased in sheet metal shield.

B. Manufacturers:

1. Carpenter & Paterson, Inc.
2. ERICO/Michigan Hanger Co.
3. PHS Industries, Inc.
4. Pipe Shields, Inc.
5. Rilco Manufacturing Company, Inc.
6. Value Engineered Products, Inc.

C. Insulation-Insert Material for Cold Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate with vapor barrier.

D. Insulation-Insert Material for Hot Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate.

E. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.

F. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.

G. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.06 FASTENER SYSTEMS

A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

1. Manufacturers:
   a. Hilti, Inc.
   b. ITW Ramset/Red Head.
   c. Masterset Fastening Systems, Inc.
   d. MKT Fastening, LLC.
   e. Powers Fasteners.

B. Mechanical-Expansion Anchors: Insert-wedge-type zinc-coated steel, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

1. Manufacturers:
   a. B-Line Systems, Inc.; a division of Cooper Industries.
   b. Empire Industries, Inc.
   c. Hilti, Inc.
   d. ITW Ramset/Red Head.
   e. MKT Fastening, LLC.
   f. Powers Fasteners.

2.07 PIPE STAND FABRICATION

A. Pipe Stands, General: Shop or field-fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted piping.

B. Compact Pipe Stand: One-piece plastic unit with integral-rod-roller, pipe clamps, or V-shaped cradle to support pipe, for roof installation without membrane penetration.

1. Manufacturers:
    a. ERICO/Michigan Hanger Co.
    b. MIRO Industries.

C. Low-Type, Single-Pipe Stand: One-piece stainless-steel base unit with plastic roller, for roof installation without membrane penetration.
1. Manufacturers:
    a. MIRO Industries.

D. High-Type, Single-Pipe Stand: Assembly of base, vertical and horizontal members, and pipe support, for roof installation without membrane penetration.
1. Manufacturers:
    a. ERICO/Michigan Hanger Co.
    b. MIRO Industries.
    c. Portable Pipe Hangers.
2. Base: Stainless steel.
3. Vertical Members: Two or more cadmium-plated-steel or stainless-steel, continuous-thread rods.
4. Horizontal Member: Cadmium-plated-steel or stainless-steel rod with plastic or stainless-steel, roller-type pipe support.

E. High-Type, Multiple-Pipe Stand: Assembly of bases, vertical and horizontal members, and pipe supports, for roof installation without membrane penetration.
1. Manufacturers:
    a. Portable Pipe Hangers.
2. Bases: One or more plastic.
3. Vertical Members: Two or more protective-coated-steel channels.
4. Horizontal Member: Protective-coated-steel channel.
5. Pipe Supports: Galvanized-steel, clevis-type pipe hangers.

F. Curb-Mounting-Type Pipe Stands: Shop- or field-fabricated pipe support made from structural-steel shape, continuous-thread rods, and rollers for mounting on permanent stationary roof curb.

2.08 EQUIPMENT SUPPORTS

A. Description: Welded, shop- or field-fabricated equipment support made from structural-steel shapes.

2.09 MISCELLANEOUS MATERIALS

A. Structural Steel: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
1. Properties: Nonstaining, noncorrosive, and nongaseous.
2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.01 HANGER AND SUPPORT APPLICATIONS

A. Specific hanger and support requirements are specified in Sections specifying piping systems and equipment.

B. Comply with MSS SP-69 for pipe hanger selections and applications that are not specified in piping system Sections.

C. Use hangers and supports with galvanized, metallic coatings for piping and equipment that will not have field-applied finish.

D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.

E. Use padded hangers for piping that is subject to scratching.

F. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated stationary pipes, NPS 1/2 to NPS 30.
2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of 120 to 450 deg F pipes, NPS 4 to NPS 16, requiring up to 4 inches of insulation.
3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes, NPS 3/4 to NPS 24, requiring clamp flexibility and up to 4 inches of insulation.
4. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes, NPS 1/2 to NPS 24, if little or no insulation is required.
5. Pipe Hangers (MSS Type 5): For suspension of pipes, NPS 1/2 to NPS 4 to allow off-center closure for hanger installation before pipe erection.
6. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated stationary pipes, NPS 3/4 to NPS 8.
7. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 8.
8. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 8.
9. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 2.
10. Split Pipe-Ring with or without Turnbuckle-Adjustment Hangers (MSS Type 11): For suspension of noninsulated stationary pipes, NPS 3/8 to NPS 8.
11. Extension Hinged or 2-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated stationary pipes, NPS 3/8 to NPS 3.
12. U-Bolts (MSS Type 24): For support of heavy pipes, NPS 1/2 to NPS 30.
13. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
14. Pipe Saddle Supports (MSS Type 36): For support of pipes, NPS 4 to NPS 36, with steel pipe base stanchion support and cast-iron floor flange.
15. Pipe Stanchion Saddles (MSS Type 37): For support of pipes, NPS 4 to NPS 36, with steel pipe base stanchion support and cast-iron floor flange and with U-bolt to retain pipe.
16. Adjustable, Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes, NPS 2-1/2 to NPS 36, if vertical adjustment is required, with steel pipe base stanchion support and cast-iron floor flange.
17. Single Pipe Rolls (MSS Type 41): For suspension of pipes, NPS 1 to NPS 30, from 2 rods if longitudinal movement caused by expansion and contraction might occur.
18. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes, NPS 2-1/2 to NPS 20, from single rod if horizontal movement caused by expansion and contraction might occur.
19. Complete Pipe Rolls (MSS Type 44): For support of pipes, NPS 2 to NPS 42, if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.
20. Pipe Roll and Plate Units (MSS Type 45): For support of pipes, NPS 2 to NPS 24, if small horizontal movement caused by expansion and contraction might occur and vertical adjustment is not necessary.
21. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes, NPS 2 to NPS 30, if vertical and lateral adjustment during installation might be required in addition to expansion and contraction.

G. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers, NPS 3/4 to NPS 20.
2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers, NPS 3/4 to NPS 20if longer ends are required for riser clamps.

H. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.

I. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction to attach to top flange of structural shape.
3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
6. C-Clamps (MSS Type 23): For structural shapes.
7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
11. Malleable Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
12. Welded-Steel Brackets: For support of pipes from below, or for suspending from above by using clip and rod. Use one of the following for indicated loads:
    a. Light (MSS Type 31): 750 lb.
    b. Medium (MSS Type 32): 1500 lb.
    c. Heavy (MSS Type 33): 3000 lb.
13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.

J. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.

K. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Restraint-Control Devices (MSS Type 47): Where indicated to control piping movement.

2. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
3. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41 roll hanger with springs.
4. Spring Sway Braces (MSS Type 50): To retard sway, shock, vibration, or thermal expansion in piping systems.
5. Variable-Spring Hangers (MSS Type 51): Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from hanger.
6. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from base support.
7. Variable-Spring Trapeze Hangers (MSS Type 53): Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from trapeze support.
8. Constant Supports: For critical piping stress and if necessary to avoid transfer of stress from one support to another support, critical terminal, or connected equipment. Include auxiliary stops for erection, hydrostatic test, and load-adjustment capability. These supports include the following types:
    a. Horizontal (MSS Type 54): Mounted horizontally.
    b. Vertical (MSS Type 55): Mounted vertically.
    c. Trapeze (MSS Type 56): Two vertical-type supports and one trapeze member.

L. Comply with MSS SP-69 for trapeze pipe hanger selections and applications that are not specified in piping system Sections.

M. Comply with MFMA-102 for metal framing system selections and applications that are not specified in piping system Sections.

N. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.

3.02 HANGER AND SUPPORT INSTALLATION

A. Steel Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.

B. Trapeze Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping and support together on field-fabricated trapeze pipe hangers.
1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified above for individual pipe hangers.
2. Field fabricate from ASTM A 36/A 36M, steel shapes selected for loads being supported. Weld steel according to AWS D1.1.

C. Metal Framing System Installation: Arrange for grouping of parallel runs of piping and support together on field-assembled metal framing systems.

D. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.

E. Fastener System Installation:
1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches (100 mm) thick in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.

F. Pipe Stand Installation:
1. Pipe Stand Types except Curb-Mounting Type: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.
2. Curb-Mounting-Type Pipe Stands: Assemble components or fabricate pipe stand and mount on permanent, stationary roof curb. Refer to Division 07 Section "Roof Accessories" for curbs.

G. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.

H. Equipment Support Installation: Fabricate from welded-structural-steel shapes.

I. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

J. Install lateral bracing with pipe hangers and supports to prevent swaying.

K. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.

L. Load Distribution: Install hangers and supports so piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

M. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so maximum pipe deflections allowed by ASME B31.1 (for power piping) and ASME B31.9 (for building services piping) are not exceeded.

N. Insulated Piping: Comply with the following:

1. Attach clamps and spacers to piping.
    a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
    b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
    c. Do not exceed pipe stress limits according to ASME B31.1 for power piping and ASME B31.9 for building services piping.
2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
    a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
    a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
4. Shield Dimensions for Pipe: Not less than the following:
    a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
    b. NPS 4: 12 inches long and 0.06 inch thick.
    c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
    d. NPS 8 to NPS 14: 24 inches long and 0.075 inch thick.
    e. NPS 16 to NPS 24: 24 inches long and 0.105 inch thick.
5. Pipes NPS 8 and Larger: Include wood inserts.
6. Insert Material: Length at least as long as protective shield.
7. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.03 EQUIPMENT SUPPORTS

A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.

B. Grouting: Place grout under supports for equipment and make smooth bearing surface.

C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.04 METAL FABRICATIONS

A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.

B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.

C. Field Welding: Comply with AWS D1.1 procedures for shielded metal arc welding, appearance and quality of welds, and methods used in correcting welding work, and with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. Finish welds at exposed connections so no roughness shows after finishing and contours of welded surfaces match adjacent contours.

3.05 ADJUSTING

A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches

3.06 PAINTING

A. Touch Up: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.

1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.

B. Touch Up: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Division 09 painting Sectiion.

C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 23 0529

SECTION 230593

TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes:

1. Balancing Air Systems:
    a. Constant-volume air systems.
    b. Variable-air-volume systems.
2. Balancing Hydronic Piping Systems:
    a. Variable-flow hydronic systems.

1.03 DEFINITIONS

A. AABC: Associated Air Balance Council.

B. NEBB: National Environmental Balancing Bureau.

C. TAB: Testing, adjusting, and balancing.

D. TABB: Testing, Adjusting, and Balancing Bureau.

E. TAB Specialist: An entity engaged to perform TAB Work.

1.04 SUBMITTALS

A. Qualification Data: Within **15** days of Contractor's Notice to Proceed, submit documentation that the TAB contractor and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article.

B. Contract Documents Examination Report: Within **15** days of Contractor's Notice to Proceed, submit the Contract Documents review report as specified in Part 3.

C. Strategies and Procedures Plan: Within **30** days of Contractor's Notice to Proceed, submit TAB strategies and step-by-step procedures as specified in "Preparation" Article.

D. Certified TAB reports.

E. Sample report forms.

F. Instrument calibration reports, to include the following:

1. Instrument type and make.
2. Serial number.
3. Application.
4. Dates of use.
5. Dates of calibration.

1.05 QUALITY ASSURANCE

A. TAB Contractor Qualifications: Engage a TAB entity certified by **NEBB**.

1. TAB Field Supervisor: Employee of the TAB contractor and certified by NEBB.
2. TAB Technician: Employee of the TAB contractor and who is certified by NEBB as a TAB technician.

B. TAB Conference: Meet with Construction Manager on approval of the TAB strategies and procedures plan to develop a mutual understanding of the details. Require the participation of the TAB field supervisor and technicians. Provide seven days' advance notice of scheduled meeting time and location.

1. Agenda Items:
    a. The Contract Documents examination report.
    b. The TAB plan.
    c. Coordination and cooperation of trades and subcontractors.
    d. Coordination of documentation and communication flow.

C. Certify TAB field data reports and perform the following:
    1. Review field data reports to validate accuracy of data and to prepare certified TAB reports.
    2. Certify that the TAB team complied with the approved TAB plan and the procedures specified and referenced in this Specification.

D. TAB Report Forms: Use standard TAB contractor's forms approved by Construction Manager.

E. Instrumentation Type, Quantity, Accuracy, and Calibration: As described in ASHRAE 111, Section 5, "Instrumentation."

1.06 PROJECT CONDITIONS

A. Full Owner Occupancy: Owner will occupy the site and existing building during entire TAB period. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

B. Partial Owner Occupancy: Owner may occupy completed areas of building before Substantial Completion. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

1.07 COORDINATION

A. Notice: Provide **seven** days' advance notice for each test. Include scheduled test dates and times.

B. Perform TAB after leakage and pressure tests on air and water distribution systems have been satisfactorily completed.

PART 2 - EXECUTION

2.01 EXAMINATION

A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems' designs that may preclude proper TAB of systems and equipment.

B. Examine systems for installed balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers. Verify that locations of these balancing devices are accessible.

C. Examine the approved submittals for HVAC systems and equipment.

D. Examine design data including HVAC system descriptions, statements of design assumptions for environmental conditions and systems' output, and statements of philosophies and assumptions about HVAC system and equipment controls.

E. Examine ceiling plenums and underfloor air plenums used for supply, return, or relief air to verify that they meet the leakage class of connected ducts as specified in Division 23 Section "Metal Ducts" and are properly separated from adjacent areas. Verify that penetrations in plenum walls are sealed and fire-stopped if required.

F. Examine equipment performance data including fan and pump curves.
    1. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
    2. Calculate system-effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from the conditions used to rate equipment performance. To calculate system effects for air systems, use tables and charts found in

AMCA 201, "Fans and Systems," or in SMACNA's "HVAC Systems - Duct Design." Compare results with the design data and installed conditions.

G. Examine system and equipment installations and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.

H. Examine test reports specified in individual system and equipment Sections.

I. Examine HVAC equipment and filters and verify that bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.

J. Examine terminal units, such as variable-air-volume boxes, and verify that they are accessible and their controls are connected and functioning.

K. Examine strainers. Verify that startup screens are replaced by permanent screens with indicated perforations.

L. Examine three-way valves for proper installation for their intended function of diverting or mixing fluid flows.

M. Examine heat-transfer coils for correct piping connections and for clean and straight fins.

N. Examine system pumps to ensure absence of entrained air in the suction piping.

O. Examine operating safety interlocks and controls on HVAC equipment.

P. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

2.02 PREPARATION

A. Prepare a TAB plan that includes strategies and step-by-step procedures.

B. Complete system-readiness checks and prepare reports. Verify the following:

1. Permanent electrical-power wiring is complete.
2. Hydronic systems are filled, clean, and free of air.
3. Automatic temperature-control systems are operational.
4. Equipment and duct access doors are securely closed.
5. Balance, smoke, and fire dampers are open.
6. Isolating and balancing valves are open and control valves are operational.
7. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.
8. Windows and doors can be closed so indicated conditions for system operations can be met.

2.03 GENERAL PROCEDURES FOR TESTING AND BALANCING

A. Perform testing and balancing procedures on each system according to the procedures contained in NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" and in this Section.

1. Comply with requirements in ASHRAE 62.1-2004, Section 7.2.2, "Air Balancing."

B. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary for TAB procedures.

1. After testing and balancing, patch probe holes in ducts with same material and thickness as used to construct ducts.
2. After testing and balancing, install test ports and duct access doors that comply with requirements in Division 23 Section "Air Duct Accessories."
3. Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish according to Division 23 Section "HVAC Insulation."

C. Mark equipment and balancing devices, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, with paint or other suitable, permanent identification material to show final settings.

D. Take and report testing and balancing measurements in **inch-pound (IP)** units.

2.04 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes.

B. Prepare schematic diagrams of systems' "as-built" duct layouts.

C. For variable-air-volume systems, develop a plan to simulate diversity.

D. Determine the best locations in main and branch ducts for accurate duct-airflow measurements.

E. Check airflow patterns from the outdoor-air louvers and dampers and the return- and exhaust-air dampers through the supply-fan discharge and mixing dampers.

F. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.

G. Verify that motor starters are equipped with properly sized thermal protection.

H. Check dampers for proper position to achieve desired airflow path.

I. Check for airflow blockages.

J. Check condensate drains for proper connections and functioning.

K. Check for proper sealing of air-handling-unit components.

L. Verify that air duct system is sealed as specified in Division 23 Section "Metal Ducts."

2.05 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.

1. Measure total airflow.
    a. Where sufficient space in ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow.
2. Measure fan static pressures as follows to determine actual static pressure:
    a. Measure outlet static pressure as far downstream from the fan as practical and upstream from restrictions in ducts such as elbows and transitions.
    b. Measure static pressure directly at the fan outlet or through the flexible connection.
    c. Measure inlet static pressure of single-inlet fans in the inlet duct as near the fan as possible, upstream from the flexible connection, and downstream from duct restrictions.
    d. Measure inlet static pressure of double-inlet fans through the wall of the plenum that houses the fan.
3. Measure static pressure across each component that makes up an air-handling unit, rooftop unit, and other air-handling and -treating equipment.
    a. Report the cleanliness status of filters and the time static pressures are measured.
4. Measure static pressures entering and leaving other devices, such as sound traps, heat-recovery equipment, and air washers, under final balanced conditions.
5. Review Record Documents to determine variations in design static pressures versus actual static pressures. Calculate actual system-effect factors. Recommend adjustments to accommodate actual conditions.
6. Obtain approval from Construction Manager for adjustment of fan speed higher or lower than indicated speed. Comply with requirements in Division 23 Sections for air-handling

units for adjustment of fans, belts, and pulley sizes to achieve indicated air-handling-unit performance.

7. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload will occur. Measure amperage in full-cooling, full-heating, economizer, and any other operating mode to determine the maximum required brake horsepower.

B. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows within specified tolerances.

1. Measure airflow of submain and branch ducts.

a. Where sufficient space in submain and branch ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow for that zone.

2. Measure static pressure at a point downstream from the balancing damper, and adjust volume dampers until the proper static pressure is achieved.

3. Remeasure each submain and branch duct after all have been adjusted. Continue to adjust submain and branch ducts to indicated airflows within specified tolerances.

C. Measure air outlets and inlets without making adjustments.

1. Measure terminal outlets using a direct-reading hood or outlet manufacturer's written instructions and calculating factors.

D. Adjust air outlets and inlets for each space to indicated airflows within specified tolerances of indicated values. Make adjustments using branch volume dampers rather than extractors and the dampers at air terminals.

1. Adjust each outlet in same room or space to within specified tolerances of indicated quantities without generating noise levels above the limitations prescribed by the Contract Documents.

2. Adjust patterns of adjustable outlets for proper distribution without drafts.

2.06 PROCEDURES FOR VARIABLE-AIR-VOLUME SYSTEMS

A. Compensating for Diversity: When the total airflow of all terminal units is more than the indicated airflow of the fan, place a selected number of terminal units at a minimum set-point airflow with the remainder at maximum-airflow condition until the total airflow of the terminal units equals the indicated airflow of the fan. Select the reduced-airflow terminal units so they are distributed evenly among the branch ducts.

B. Pressure-Independent, Variable-Air-Volume Systems: After the fan systems have been adjusted, adjust the variable-air-volume systems as follows:

1. Set outdoor-air dampers at minimum, and set return- and exhaust-air dampers at a position that simulates full-cooling load.

2. Select the terminal unit that is most critical to the supply-fan airflow and static pressure. Measure static pressure. Adjust system static pressure so the entering static pressure for the critical terminal unit is not less than the sum of the terminal-unit manufacturer's recommended minimum inlet static pressure plus the static pressure needed to overcome terminal-unit discharge system losses.

3. Measure total system airflow. Adjust to within indicated airflow.

4. Set terminal units at maximum airflow and adjust controller or regulator to deliver the designed maximum airflow. Use terminal-unit manufacturer's written instructions to make this adjustment. When total airflow is correct, balance the air outlets downstream from terminal units the same as described for constant-volume air systems.

5. Set terminal units at minimum airflow and adjust controller or regulator to deliver the designed minimum airflow. Check air outlets for a proportional reduction in airflow the same as described for constant-volume air systems.
    a. If air outlets are out of balance at minimum airflow, report the condition but leave outlets balanced for maximum airflow.
6. Remeasure the return airflow to the fan while operating at maximum return airflow and minimum outdoor airflow.
    a. Adjust the fan and balance the return-air ducts and inlets the same as described for constant-volume air systems.
7. Measure static pressure at the most critical terminal unit and adjust the static-pressure controller at the main supply-air sensing station to ensure that adequate static pressure is maintained at the most critical unit.
8. Record final fan-performance data.

C. Pressure-Dependent, Variable-Air-Volume Systems without Diversity: After the fan systems have been adjusted, adjust the variable-air-volume systems as follows:
1. Balance variable-air-volume systems the same as described for constant-volume air systems.
2. Set terminal units and supply fan at full-airflow condition.
3. Adjust inlet dampers of each terminal unit to indicated airflow and verify operation of the static-pressure controller. When total airflow is correct, balance the air outlets downstream from terminal units the same as described for constant-volume air systems.
4. Readjust fan airflow for final maximum readings.
5. Measure operating static pressure at the sensor that controls the supply fan if one is installed, and verify operation of the static-pressure controller.
6. Set supply fan at minimum airflow if minimum airflow is indicated. Measure static pressure to verify that it is being maintained by the controller.
7. Set terminal units at minimum airflow and adjust controller or regulator to deliver the designed minimum airflow. Check air outlets for a proportional reduction in airflow the same as described for constant-volume air systems.
    a. If air outlets are out of balance at minimum airflow, report the condition but leave the outlets balanced for maximum airflow.
8. Measure the return airflow to the fan while operating at maximum return airflow and minimum outdoor airflow.
    a. Adjust the fan and balance the return-air ducts and inlets the same as described for constant-volume air systems.

D. Pressure-Dependent, Variable-Air-Volume Systems with Diversity: After the fan systems have been adjusted, adjust the variable-air-volume systems as follows:
1. Set system at maximum indicated airflow by setting the required number of terminal units at minimum airflow. Select the reduced-airflow terminal units so they are distributed evenly among the branch ducts.
2. Adjust supply fan to maximum indicated airflow with the variable-airflow controller set at maximum airflow.
3. Set terminal units at full-airflow condition.
4. Adjust terminal units starting at the supply-fan end of the system and continuing progressively to the end of the system. Adjust inlet dampers of each terminal unit to indicated airflow. When total airflow is correct, balance the air outlets downstream from terminal units the same as described for constant-volume air systems.
5. Adjust terminal units for minimum airflow.

6. Measure static pressure at the sensor.
7. Measure the return airflow to the fan while operating at maximum return airflow and minimum outdoor airflow. Adjust the fan and balance the return-air ducts and inlets the same as described for constant-volume air systems.

2.07 GENERAL PROCEDURES FOR HYDRONIC SYSTEMS

A. Prepare test reports with pertinent design data, and number in sequence starting at pump to end of system. Check the sum of branch-circuit flows against the approved pump flow rate. Correct variations that exceed plus or minus 5 percent.

B. Prepare schematic diagrams of systems' "as-built" piping layouts.

C. Prepare hydronic systems for testing and balancing according to the following, in addition to the general preparation procedures specified above:

1. Open all manual valves for maximum flow.
2. Check liquid level in expansion tank.
3. Check makeup water-station pressure gage for adequate pressure for highest vent.
4. Check flow-control valves for specified sequence of operation, and set at indicated flow.
5. Set differential-pressure control valves at the specified differential pressure. Do not set at fully closed position when pump is positive-displacement type unless several terminal valves are kept open.
6. Set system controls so automatic valves are wide open to heat exchangers.
7. Check pump-motor load. If motor is overloaded, throttle main flow-balancing device so motor nameplate rating is not exceeded.
8. Check air vents for a forceful liquid flow exiting from vents when manually operated.

2.08 PROCEDURES FOR VARIABLE-FLOW HYDRONIC SYSTEMS

A. Balance systems with automatic two- and three-way control valves by setting systems at maximum flow through heat-exchange terminals and proceed as specified above for hydronic systems.

2.09 PROCEDURES FOR MOTORS

A. Motors, 1/2 HP and Larger: Test at final balanced conditions and record the following data:

1. Manufacturer's name, model number, and serial number.
2. Motor horsepower rating.
3. Motor rpm.
4. Efficiency rating.
5. Nameplate and measured voltage, each phase.
6. Nameplate and measured amperage, each phase.
7. Starter thermal-protection-element rating.

B. Motors Driven by Variable-Frequency Controllers: Test for proper operation at speeds varying from minimum to maximum. Test the manual bypass of the controller to prove proper operation. Record observations including name of controller manufacturer, model number, serial number, and nameplate data.

2.010 PROCEDURES FOR CONDENSING UNITS

A. Verify proper rotation of fans.

B. Measure entering- and leaving-air temperatures.

C. Record compressor data.

2.011 PROCEDURES FOR BOILERS

A. Hydronic Boilers: Measure and record entering- and leaving-water temperatures and water flow.

B. Steam Boilers: Measure and record entering-water temperature and flow and leaving-steam pressure, temperature, and flow.

2.012 TOLERANCES

A. Set HVAC system's air flow rates and water flow rates within the following tolerances:

1. Supply, Return, and Exhaust Fans and Equipment with Fans: Plus or minus 10 percent.
2. Air Outlets and Inlets: Plus or minus 10 percent.
3. Heating-Water Flow Rate: Plus or minus 10 percent.
4. Cooling-Water Flow Rate: Plus or minus 10 percent.

2.013 REPORTING

A. Initial Construction-Phase Report: Based on examination of the Contract Documents as specified in "Examination" Article, prepare a report on the adequacy of design for systems' balancing devices. Recommend changes and additions to systems' balancing devices to facilitate proper performance measuring and balancing. Recommend changes and additions to HVAC systems and general construction to allow access for performance measuring and balancing devices.

B. Status Reports: Prepare weekly progress reports to describe completed procedures, procedures in progress, and scheduled procedures. Include a list of deficiencies and problems found in systems being tested and balanced. Prepare a separate report for each system and each building floor for systems serving multiple floors.

2.014 FINAL REPORT

A. General: Prepare a certified written report; tabulate and divide the report into separate sections for tested systems and balanced systems.

1. Include a certification sheet at the front of the report's binder, signed and sealed by the certified testing and balancing engineer.
2. Include a list of instruments used for procedures, along with proof of calibration.

B. Final Report Contents: In addition to certified field-report data, include the following:

1. Pump curves.
2. Fan curves.
3. Manufacturers' test data.
4. Field test reports prepared by system and equipment installers.
5. Other information relative to equipment performance; do not include Shop Drawings and product data.

C. General Report Data: In addition to form titles and entries, include the following data:

1. Title page.
2. Name and address of the TAB contractor.
3. Project name.
4. Project location.
5. Architect's name and address.
6. Engineer's name and address.
7. Contractor's name and address.
8. Report date.
9. Signature of TAB supervisor who certifies the report.

10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
11. Summary of contents including the following:
    a. Indicated versus final performance.
    b. Notable characteristics of systems.
    c. Description of system operation sequence if it varies from the Contract Documents.
12. Nomenclature sheets for each item of equipment.
13. Data for terminal units, including manufacturer's name, type, size, and fittings.
14. Notes to explain why certain final data in the body of reports vary from indicated values.
15. Test conditions for fans and pump performance forms including the following:
    a. Settings for outdoor-, return-, and exhaust-air dampers.
    b. Conditions of filters.
    c. Cooling coil, wet- and dry-bulb conditions.
    d. Face and bypass damper settings at coils.
    e. Fan drive settings including settings and percentage of maximum pitch diameter.
    f. Inlet vane settings for variable-air-volume systems.
    g. Settings for supply-air, static-pressure controller.
    h. Other system operating conditions that affect performance.

D. System Diagrams: Include schematic layouts of air and hydronic distribution systems. Present each system with single-line diagram and include the following:
1. Quantities of outdoor, supply, return, and exhaust airflows.
2. Water and steam flow rates.
3. Duct, outlet, and inlet sizes.
4. Pipe and valve sizes and locations.
5. Terminal units.
6. Balancing stations.
7. Position of balancing devices.

E. Air-Handling-Unit Test Reports: For air-handling units with coils, include the following:
1. Unit Data:
    a. Unit identification.
    b. Location.
    c. Make and type.
    d. Model number and unit size.
    e. Manufacturer's serial number.
    f. Unit arrangement and class.
    g. Discharge arrangement.
    h. Sheave make, size in inches (mm), and bore.
    i. Center-to-center dimensions of sheave, and amount of adjustments in inches (mm).
    j. Number, make, and size of belts.
    k. Number, type, and size of filters.
2. Motor Data:

a. Motor make, and frame type and size.
b. Horsepower and rpm.
c. Volts, phase, and hertz.
d. Full-load amperage and service factor.
e. Sheave make, size in inches (mm), and bore.
f. Center-to-center dimensions of sheave, and amount of adjustments in inches (mm).

3. Test Data (Indicated and Actual Values):
a. Total air flow rate in cfm (L/s).
b. Total system static pressure in inches wg (Pa).
c. Fan rpm.
d. Discharge static pressure in inches wg (Pa).
e. Filter static-pressure differential in inches wg (Pa).
f. Preheat-coil static-pressure differential in inches wg (Pa).
g. Cooling-coil static-pressure differential in inches wg (Pa).
h. Heating-coil static-pressure differential in inches wg (Pa).
i. Outdoor airflow in cfm (L/s).
j. Return airflow in cfm (L/s).
k. Outdoor-air damper position.
l. Return-air damper position.
m. Vortex damper position.

F. Apparatus-Coil Test Reports:
1. Coil Data:
a. System identification.
b. Location.
c. Coil type.
d. Number of rows.
e. Fin spacing in fins per inch (mm) o.c.
f. Make and model number.
g. Face area in sq. ft. (sq. m).
h. Tube size in NPS (DN).
i. Tube and fin materials.
j. Circuiting arrangement.

2. Test Data (Indicated and Actual Values):
a. Air flow rate in cfm (L/s).
b. Average face velocity in fpm (m/s).
c. Air pressure drop in inches wg (Pa).
d. Outdoor-air, wet- and dry-bulb temperatures in deg F (deg C).
e. Return-air, wet- and dry-bulb temperatures in deg F (deg C).
f. Entering-air, wet- and dry-bulb temperatures in deg F (deg C).
g. Leaving-air, wet- and dry-bulb temperatures in deg F (deg C).
h. Water flow rate in gpm (L/s).

i. Water pressure differential in feet of head or psig (kPa).
j. Entering-water temperature in deg F (deg C).
k. Leaving-water temperature in deg F (deg C).
l. Refrigerant expansion valve and refrigerant types.
m. Refrigerant suction pressure in psig (kPa).
n. Refrigerant suction temperature in deg F (deg C).
o. Inlet steam pressure in psig (kPa).

G. Gas- and Oil-Fired Heat Apparatus Test Reports: In addition to manufacturer's factory startup equipment reports, include the following:

1. Unit Data:
   a. System identification.
   b. Location.
   c. Make and type.
   d. Model number and unit size.
   e. Manufacturer's serial number.
   f. Fuel type in input data.
   g. Output capacity in Btu/h (kW).
   h. Ignition type.
   i. Burner-control types.
   j. Motor horsepower and rpm.
   k. Motor volts, phase, and hertz.
   l. Motor full-load amperage and service factor.
   m. Sheave make, size in inches (mm), and bore.
   n. Center-to-center dimensions of sheave, and amount of adjustments in inches (mm).
2. Test Data (Indicated and Actual Values):
   a. Total air flow rate in cfm (L/s).
   b. Entering-air temperature in deg F (deg C).
   c. Leaving-air temperature in deg F (deg C).
   d. Air temperature differential in deg F (deg C).
   e. Entering-air static pressure in inches wg (Pa).
   f. Leaving-air static pressure in inches wg (Pa).
   g. Air static-pressure differential in inches wg (Pa).
   h. Low-fire fuel input in Btu/h (kW).
   i. High-fire fuel input in Btu/h (kW).
   j. Manifold pressure in psig (kPa).
   k. High-temperature-limit setting in deg F (deg C).
   l. Operating set point in Btu/h (kW).
   m. Motor voltage at each connection.
   n. Motor amperage for each phase.
   o. Heating value of fuel in Btu/h (kW).

H. Fan Test Reports: For supply, return, and exhaust fans, include the following:

1. Fan Data:
    a. System identification.
    b. Location.
    c. Make and type.
    d. Model number and size.
    e. Manufacturer's serial number.
    f. Arrangement and class.
    g. Sheave make, size in inches (mm), and bore.
    h. Center-to-center dimensions of sheave, and amount of adjustments in inches (mm).
2. Motor Data:
    a. Motor make, and frame type and size.
    b. Horsepower and rpm.
    c. Volts, phase, and hertz.
    d. Full-load amperage and service factor.
    e. Sheave make, size in inches (mm), and bore.
    f. Center-to-center dimensions of sheave, and amount of adjustments in inches (mm).
    g. Number, make, and size of belts.
3. Test Data (Indicated and Actual Values):
    a. Total airflow rate in cfm (L/s).
    b. Total system static pressure in inches wg (Pa).
    c. Fan rpm.
    d. Discharge static pressure in inches wg (Pa).
    e. Suction static pressure in inches wg (Pa).

I. Round, Flat-Oval, and Rectangular Duct Traverse Reports: Include a diagram with a grid representing the duct cross-section and record the following:
1. Report Data:
    a. System and air-handling-unit number.
    b. Location and zone.
    c. Traverse air temperature in deg F (deg C).
    d. Duct static pressure in inches wg (Pa).
    e. Duct size in inches (mm).
    f. Duct area in sq. ft. (sq. m).
    g. Indicated air flow rate in cfm (L/s).
    h. Indicated velocity in fpm (m/s).
    i. Actual air flow rate in cfm (L/s).
    j. Actual average velocity in fpm (m/s).
    k. Barometric pressure in psig (Pa).

J. Air-Terminal-Device Reports:
1. Unit Data:
    a. System and air-handling unit identification.

b. Location and zone.
c. Apparatus used for test.
d. Area served.
e. Make.
f. Number from system diagram.
g. Type and model number.
h. Size.
i. Effective area in sq. ft. (sq. m).

2. Test Data (Indicated and Actual Values):
a. Air flow rate in cfm (L/s).
b. Air velocity in fpm (m/s).
c. Preliminary air flow rate as needed in cfm (L/s).
d. Preliminary velocity as needed in fpm (m/s).
e. Final air flow rate in cfm (L/s).
f. Final velocity in fpm (m/s).
g. Space temperature in deg F (deg C).

K. System-Coil Reports: For reheat coils and water coils of terminal units, include the following:
1. Unit Data:
a. System and air-handling-unit identification.
b. Location and zone.
c. Room or riser served.
d. Coil make and size.
e. Flowmeter type.

2. Test Data (Indicated and Actual Values):
a. Air flow rate in cfm (L/s).
b. Entering-water temperature in deg F (deg C).
c. Leaving-water temperature in deg F (deg C).
d. Water pressure drop in feet of head or psig (kPa).
e. Entering-air temperature in deg F (deg C).
f. Leaving-air temperature in deg F (deg C).

L. Pump Test Reports: Calculate impeller size by plotting the shutoff head on pump curves and include the following:
1. Unit Data:
a. Unit identification.
b. Location.
c. Service.
d. Make and size.
e. Model number and serial number.
f. Water flow rate in gpm (L/s).
g. Water pressure differential in feet of head or psig (kPa).
h. Required net positive suction head in feet of head or psig (kPa).
i. Pump rpm.

j. Impeller diameter in inches (mm).
k. Motor make and frame size.
l. Motor horsepower and rpm.
m. Voltage at each connection.
n. Amperage for each phase.
o. Full-load amperage and service factor.
p. Seal type.

2. Test Data (Indicated and Actual Values):
a. Static head in feet of head or psig (kPa).
b. Pump shutoff pressure in feet of head or psig (kPa).
c. Actual impeller size in inches (mm).
d. Full-open flow rate in gpm (L/s).
e. Full-open pressure in feet of head or psig (kPa).
f. Final discharge pressure in feet of head or psig (kPa).
g. Final suction pressure in feet of head or psig (kPa).
h. Final total pressure in feet of head or psig (kPa).
i. Final water flow rate in gpm (L/s).
j. Voltage at each connection.
k. Amperage for each phase.

M. Instrument Calibration Reports:
1. Report Data:
a. Instrument type and make.
b. Serial number.
c. Application.
d. Dates of use.
e. Dates of calibration.

2.015 INSPECTIONS

A. Initial Inspection:
1. After testing and balancing are complete, operate each system and randomly check measurements to verify that the system is operating according to the final test and balance readings documented in the final report.
2. Check the following for each system:
a. Measure airflow of at least **10** percent of air outlets.
b. Measure water flow of at least **5** percent of terminals.
c. Measure room temperature at each thermostat/temperature sensor. Compare the reading to the set point.
d. Verify that balancing devices are marked with final balance position.
e. Note deviations from the Contract Documents in the final report.

B. Final Inspection:
1. After initial inspection is complete and documentation by random checks verifies that testing and balancing are complete and accurately documented in the final report, request that a final inspection be made by Construction Manager.

2. The TAB contractor's test and balance engineer shall conduct the inspection in the presence of Construction Manager.

3. Construction Manager shall randomly select measurements, documented in the final report, to be rechecked. Rechecking shall be limited to either 10 percent of the total measurements recorded or the extent of measurements that can be accomplished in a normal 8-hour business day.

4. If rechecks yield measurements that differ from the measurements documented in the final report by more than the tolerances allowed, the measurements shall be noted as "FAILED."

5. If the number of "FAILED" measurements is greater than 10 percent of the total measurements checked during the final inspection, the testing and balancing shall be considered incomplete and shall be rejected.

C. TAB Work will be considered defective if it does not pass final inspections. If TAB Work fails, proceed as follows:

1. Recheck all measurements and make adjustments. Revise the final report and balancing device settings to include all changes; resubmit the final report and request a second final inspection.

2. If the second final inspection also fails, Owner may contract the services of another TAB contractor to complete TAB Work according to the Contract Documents and deduct the cost of the services from the original TAB contractor's final payment.

D. Prepare test and inspection reports.

E. All fire and/or smoke dampers to be operated prior to the final inspection, to verify they function in accordance with NFPA 90A requirements. (NFPA 90A, 7.2)

END OF SECTION 23 0593

SECTION 23 0700

HVAC INSULATION

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Insulation Materials:
    a. Cellular glass.
    b. Flexible elastomeric.
    c. Mineral fiber.
    d. Polyolefin.
    e. Polystyrene.
2. Fire-rated insulation systems.
3. Insulating cements.
4. Adhesives.
5. Mastics.
6. Sealants.
7. Factory-applied jackets.
8. Field-applied fabric-reinforcing mesh.
9. Field-applied jackets.
10. Tapes.
11. Securements.
12. Corner angles.

B. Related Sections:

1.02 Division 21 Section "Fire-Suppression Systems Insulation."

1. Division 22 Section "Plumbing Insulation."
2. Division 23 Section "Metal Ducts" for duct liners.
3. Division 33 Section "Underground Hydronic Energy Distribution" for loose-fill pipe insulation in underground piping outside the building.
4. Division 33 Section "Underground Steam and Condensate Distribution Piping" for loose-fill pipe insulation in underground piping outside the building.

1.03 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings:

1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
2. Detail attachment and covering of heat tracing inside insulation.
3. Detail insulation application at pipe expansion joints for each type of insulation.
4. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
5. Detail removable insulation at piping specialties, equipment connections, and access panels.
6. Detail application of field-applied jackets.
7. Detail application at linkages of control devices.

8. Detail field application for each equipment type.

C. Field quality-control reports.

1.04 QUALITY ASSURANCE

A. Fire-Test-Response Characteristics: Insulation and related materials shall have fire-test-response characteristics indicated, as determined by testing identical products per ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing and inspecting agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

PART 2 - PRODUCTS

2.01 INSULATION MATERIALS

A. Comply with requirements in Part 3 schedule articles for where insulating materials shall be applied.

B. Products shall not contain asbestos, lead, mercury, or mercury compounds.

C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.

D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.

E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

F. Cellular Glass: Inorganic, incombustible, foamed or cellulated glass with annealed, rigid, hermetically sealed cells. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    a. Cell-U-Foam Corporation; Ultra-CUF.
    b. Pittsburgh Corning Corporation; Foamglas Super K.
    c. Aeroflex USA Inc; Aerocel
2. Block Insulation: ASTM C 552, Type I.
3. Special-Shaped Insulation: ASTM C 552, Type III.
4. Board Insulation: ASTM C 552, Type IV.
5. Preformed Pipe Insulation without Jacket: Comply with ASTM C 552, Type II, Class 1.
6. Preformed Pipe Insulation with Factory-Applied ASJ: Comply with ASTM C 552, Type II, Class 2.
7. Factory fabricate shapes according to ASTM C 450 and ASTM C 585.

G. Flexible Elastomeric: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials and Type II for sheet materials.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    a. Aeroflex USA Inc.; Aerocel.
    b. Armacell LLC; AP Armaflex.
    c. RBX Corporation; Insul-Sheet 1800 and Insul-Tube 180.

H. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, Type I. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. CertainTeed Corp.; Duct Wrap.

b. Johns Manville; Microlite.

c. Knauf Insulation; Duct Wrap.

d. Manson Insulation Inc.; Alley Wrap.

e. Owens Corning; All-Service Duct Wrap.

2.02 FIRE-RATED INSULATION SYSTEMS

A. Fire-Rated Board: Structural-grade, press-molded, xonolite calcium silicate, fireproofing board suitable for operating temperatures up to 1700 deg F. Comply with ASTM C 656, Type II, Grade 6. tested and certified to provide a 1-hour fire rating by a NRTL acceptable to authority having jurisdiction.

1. Products: Subject to compliance with requirements, provide the following:

a. Johns Manville; Super Firetemp M.

B. Fire-Rated Blanket: High-temperature, flexible, blanket insulation with FSK jacket that is tested and certified to provide a [1] [2]-hour fire rating by a NRTL acceptable to authority having jurisdiction.

1. Products: Subject to compliance with requirements, provide one of the following:

a. CertainTeed Corp.; FlameChek.

b. Johns Manville; Firetemp Wrap.

c. Nelson Firestop Products; Nelson FSB Flameshield Blanket.

d. Thermal Ceramics; FireMaster Duct Wrap.

e. 3M; Fire Barrier Wrap Products.

f. Unifrax Corporation; FyreWrap.

g. Vesuvius; PYROSCAT FP FASTR Duct Wrap.

2.03 INSULATING CEMENTS

A. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449/C 449M.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Insulco, Division of MFS, Inc.; SmoothKote.

b. P. K. Insulation Mfg. Co., Inc.; PK No. 127, and Quik-Cote.

c. Rock Wool Manufacturing Company; Delta One Shot.

2.04 ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.

B. Cellular-Glass, Phenolic, Polyisocyanurate, and Polystyrene Adhesive: Solvent-based resin adhesive, with a service temperature range of minus 75 to plus 300 deg F (minus 59 to plus 149 deg C).

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    a. Childers Products, Division of ITW; CP-96.
    b. Foster Products Corporation, H. B. Fuller Company; 81-33.
    c. ITW TACC, Division of Illinois Tool Works; S-90/80.
2. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

C. Flexible Elastomeric and Polyolefin Adhesive: Comply with MIL-A-24179A, Type II, Class I.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    a. Aeroflex USA Inc.; Aeroseal.
    b. Armacell LCC; 520 Adhesive.
    c. Foster Products Corporation, H. B. Fuller Company; 85-75.
    d. RBX Corporation; Rubatex Contact Adhesive.
2. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

D. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    a. Childers Products, Division of ITW; CP-82.
    b. Foster Products Corporation, H. B. Fuller Company; 85-20.
    c. ITW TACC, Division of Illinois Tool Works; S-90/80.
    d. Marathon Industries, Inc.; 225.
    e. Mon-Eco Industries, Inc.; 22-25.
2. For indoor applications, use adhesive that has a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.05 MASTICS

A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-C-19565C, Type II.

B. Vapor-Barrier Mastic: Water based; suitable for indoor and outdoor use on below ambient services.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    a. Childers Products, Division of ITW; CP-35.
    b. Foster Products Corporation, H. B. Fuller Company; 30-90.
    c. ITW TACC, Division of Illinois Tool Works; CB-50.
    d. Marathon Industries, Inc.; 590.
    e. Mon-Eco Industries, Inc.; 55-40.
    f. Vimasco Corporation; 749.
2. Water-Vapor Permeance: ASTM E 96, Procedure B, 0.013 perm (0.009 metric perm) at 43-mil (1.09-mm) dry film thickness.
3. Service Temperature Range: Minus 20 to plus 180 deg F (Minus 29 to plus 82 deg C).
4. Solids Content: ASTM D 1644, 59 percent by volume and 71 percent by weight.
5. Color: White.

2.06 SEALANTS

A. Joint Sealants:

1. Joint Sealants for Cellular-Glass Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    a. Childers Products, Division of ITW; CP-76.
    b. Foster Products Corporation, H. B. Fuller Company; 30-45.
    c. Marathon Industries, Inc.; 405.
    d. Mon-Eco Industries, Inc.; 44-05.
    e. Pittsburgh Corning Corporation; Pittseal 444.
    f. Vimasco Corporation; 750.
2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Permanently flexible, elastomeric sealant.
4. Service Temperature Range: Minus 100 to plus 300 deg F (Minus 73 to plus 149 deg C).
5. Color: White or gray.
6. For indoor applications, use sealants that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

PART 3 - EXECUTION

3.01 PREPARATION

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

B. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.

C. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.02 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of equipment, ducts and fittings, and piping including fittings, valves, and specialties.

B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of equipment, duct system, and pipe system as specified in insulation system schedules.

C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

D. Install insulation with longitudinal seams at top and bottom of horizontal runs.

E. Install multiple layers of insulation with longitudinal and end seams staggered.

F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.

G. Keep insulation materials dry during application and finishing.

H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

I. Install insulation with least number of joints practical.

J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.

1. Install insulation continuously through hangers and around anchor attachments.

2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.

3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.

4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.

K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

L. Install insulation with factory-applied jackets as follows:

1. Draw jacket tight and smooth.

2. Cover circumferential joints with 3-inch- (75-mm-) wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches (100 mm) o.c.

3. Overlap jacket longitudinal seams at least 1-1/2 inches (38 mm). Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches (50 mm) o.c.

a. For below ambient services, apply vapor-barrier mastic over staples.

4. Cover joints and seams with tape as recommended by insulation material manufacturer to maintain vapor seal.

5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct and pipe flanges and fittings.

M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches (100 mm) beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

P. For above ambient services, do not install insulation to the following:

1. Vibration-control devices.

2. Testing agency labels and stamps.

3. Nameplates and data plates.

4. Manholes.

5. Handholes.

6. Cleanouts.

3.03 GENERAL PIPE INSULATION INSTALLATION

A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.

B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:

1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity, unless otherwise indicated.

2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.

3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.

4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.

5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below ambient services, provide a design that maintains vapor barrier.

6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.

7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below ambient services and a breather mastic for above ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.

8. For services not specified to receive a field-applied jacket except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.

9. Stencil or label the outside insulation jacket of each union with the word "UNION." Match size and color of pipe labels.

C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes, vessels, and equipment. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.

D. Install removable insulation covers at locations indicated. Installation shall conform to the following:

1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.

2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.

3. Construct removable valve insulation covers in same manner as for flanges except divide the two-part section on the vertical center line of valve body.

4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.

5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

3.04 MINERAL-FIBER INSULATION INSTALLATION

A. Blanket Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.

1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of duct and plenum surfaces.

2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.

3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:

   a. On duct sides with dimensions 18 inches (450 mm) and smaller, place pins along longitudinal centerline of duct. Space 3 inches (75 mm) maximum from insulation end joints, and 16 inches (400 mm) o.c.

   b. On duct sides with dimensions larger than 18 inches (450 mm), place pins 16 inches (400 mm) o.c. each way, and 3 inches (75 mm) maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.

   c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.

   d. Do not overcompress insulation during installation.

   e. Impale insulation over pins and attach speed washers.

   f. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.

4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches (50 mm) from 1 edge and 1 end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch (13-mm) outward-clinching staples, 1 inch (25 mm) o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.

   a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.

b. Install vapor stops for ductwork and plenums operating below 50 deg F (10 deg C) at 18-foot (5.5-m) intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to 2 times the insulation thickness but not less than 3 inches (75 mm).

5. Overlap unfaced blankets a minimum of 2 inches (50 mm) on longitudinal seams and end joints. At end joints, secure with steel bands spaced a maximum of 18 inches (450 mm) o.c.

6. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.

7. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch- (150-mm-) wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches (150 mm) o.c.

3.05 FIELD-APPLIED JACKET INSTALLATION

A. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches o.c. and at end joints.

3.06 FIRE-RATED INSULATION SYSTEM INSTALLATION

A. Where fire-rated insulation system is indicated, secure system to ducts and duct hangers and supports to maintain a continuous fire rating.

B. Insulate duct access panels and doors to achieve same fire rating as duct.

C. Install firestopping at penetrations through fire-rated assemblies. Fire-stop systems are specified in Division 07 Section "Penetration Firestopping."

3.07 FINISHES

A. Duct, Equipment, and Pipe Insulation with ASJ or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Division 09 painting Sections.

1. Flat Acrylic Finish: [Two] <Insert number> finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.

a. Finish Coat Material: Interior, flat, latex-emulsion size.

B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.

C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.

D. Do not field paint aluminum or stainless-steel jackets.

3.08 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:

1. Inspect ductwork, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to one location for each duct system defined in the "Duct Insulation Schedule, General" Article.

2. Inspect field-insulated equipment, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of

inspection shall be limited to one location for each type of equipment defined in the "Equipment Insulation Schedule" Article. For large equipment, remove only a portion adequate to determine compliance.

3. Inspect pipe, fittings, strainers, and valves, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to three locations of straight pipe, three locations of threaded fittings, three locations of welded fittings, two locations of threaded strainers, two locations of welded strainers, three locations of threaded valves, and three locations of flanged valves for each pipe service defined in the "Piping Insulation Schedule, General" Article.

C. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.09 DUCT INSULATION SCHEDULE, GENERAL

A. Plenums and Ducts Requiring Insulation:

1. Indoor, concealed supply and outdoor air.
2. Indoor, exposed supply and outdoor air.
3. Indoor, concealed return located in nonconditioned space.
4. Indoor, exposed return located in nonconditioned space.
5. Indoor, concealed, Type I, commercial, kitchen hood exhaust.
6. Indoor, exposed, Type I, commercial, kitchen hood exhaust.
7. Indoor, concealed oven and warewash exhaust.
8. Indoor, exposed oven and warewash exhaust.
9. Indoor, concealed exhaust between isolation damper and penetration of building exterior.
10. Indoor, exposed exhaust between isolation damper and penetration of building exterior.
11. Outdoor, concealed supply and return.
12. Outdoor, exposed supply and return.

B. Items Not Insulated:

1. Fibrous-glass ducts.
2. Metal ducts with duct liner of sufficient thickness to comply with energy code and ASHRAE/IESNA 90.1.
3. Factory-insulated flexible ducts.
4. Factory-insulated plenums and casings.
5. Flexible connectors.
6. Vibration-control devices.
7. Factory-insulated access panels and doors.

3.010 INDOOR DUCT AND PLENUM INSULATION SCHEDULE

A. Concealed, Supply-Air Duct and Plenum Insulation: Mineral-fiber blanket, 1-1/2 inches (38 mm) thick and 1.5-lb/cu. ft. (24-kg/cu. m)] nominal density.

B. Concealed, Return-Air Duct and Plenum Insulation: Mineral-fiber blanket, 1-1/2 inches (38 mm) thick and 1.5-lb/cu. ft. (24-kg/cu. m)] nominal density

3.011 PIPING INSULATION SCHEDULE, GENERAL

A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.

B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:

1. Drainage piping located in crawl spaces.

2. Underground piping.

3. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

3.012 INDOOR PIPING INSULATION SCHEDULE

A. Refrigerant Suction and Hot-Gas Flexible Tubing: Flexible elastomeric, 1 inch (25 mm) thick.

3.013 OUTDOOR, ABOVEGROUND PIPING INSULATION SCHEDULE

A. Refrigerant Suction and Hot-Gas Piping: Insulation shall be[one of] the following:

1. Flexible Elastomeric: 2 inches (50 mm) thick.

B. Refrigerant Suction and Hot-Gas Flexible Tubing: Insulation shall be[one of] the following:

1. Flexible Elastomeric: [2 inches (50 mm) thick.

END OF SECTION 23 0700

SECTION 23 0900

INSTRUMENTATION AND CONTROL FOR HVAC

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. This Section includes control equipment for HVAC systems and components, including control components for terminal heating and cooling units not supplied with factory-wired controls.

B. Controls contractor is responsible for all low voltage wiring, conduit, transformers, actuators, relays, sensors, ect for a turnkey controls system.

C. Controls contractor shall coordinate with the electrical and general contractor for low voltage power and data requirements.

D. See M-200s sheets for control points and Sequence of Operations.

1.03 DEFINITIONS

A. DDC: Direct digital control.

B. I/O: Input/output.

C. BacNet: A control network technology platform for designing and implementing interoperable control devices and networks.

D. MS/TP: Master slave/token passing.

E. PC: Personal computer.

F. PID: Proportional plus integral plus derivative.

G. RTD: Resistance temperature detector.

1.04 DESCRIPTION

A. General: The control system shall be as indicated on the drawings and described in the specifications, and consist of a peer-to-peer network of digital building control panels and operator workstation(s). The operator workstation shall be a personal computer (PC) including a color monitor, mouse and keyboard. The PC shall provide users an interface with the system though dynamic color graphics of building areas and systems.

B. Direct Digital Control (DDC) technology shall be used to provide the functions necessary for control of systems defined for control on this project.

C. The control system shall accommodate simultaneous multiple user operation. Access to the control system data should be limited by operator password. An operator shall be able to log onto any workstation of the control system and have access to all designated data.

D. The control system shall be designed such that each mechanical system will operate under stand-alone control. As such, in the event of a network communication failure, or the loss of other controllers, the control system shall continue to independently operate the unaffected equipment.

E. Communication between the control panels and all workstations shall be over a high-speed network. All nodes on this network shall be peers. A modem or network communications card shall be provided to for remote access to the system.

1.05 SYSTEM PERFORMANCE

A. Performance Standards. The system shall conform to the following:

1. Graphic Display. The system shall display a graphic with a minimum of 20 dynamic points with current data displayed within 20 seconds of the request.
2. Graphic Refresh. The system shall update all dynamic points with current data within [30] seconds.
3. Object Command. The maximum time between the command of a binary object by the operator and the reaction by the device shall be 10 seconds. Analog objects shall start to adjust within 10 seconds.
4. Object Scan. All changes of state and change of analog values shall be transmitted over the high-speed network such that any data used or displayed at a controller or workstation will be current, within the prior 60 seconds.

5. Alarm Response Time. The maximum time from when an object goes into alarm to when it is annunciated at the workstation shall not exceed 45 seconds.
6. Program Execution Frequency. Custom and standard applications shall be capable of running as often as once every 5 seconds. The Contractor shall be responsible for selecting execution times consistent with the mechanical process under control.
7. Performance. Programmable Controllers shall be able to execute DDC PID control loops at a selectable frequency from at least once every [5] seconds. The controller shall scan and update the process value and output generated by this calculation at this same frequency.
8. Multiple Alarm Annunciation. All workstations on the network shall receive alarms within [5] seconds of each other.
9. Reporting Accuracy. Table 1 lists minimum acceptable reporting accuracies for all values reported by the specified system.

Table 1

Reporting Accuracy

Measured Variable	Reported Accuracy
Space Temperature	±0.5°C [±1°F]
Ducted Air	±1.0°C [±2°F]
Outside Air	±1.0°C [±2°F]
Water Temperature	±0.5°C [±1°F]
Delta-T	±0.15°C[±0.25°F]
Relative Humidity	±5% RH
Water Flow	±5% of full scale
Air Flow (terminal)	±10% of reading *Note 1
Air Flow (measuring stations)	±5% of reading
Air Pressure (ducts)	±25 Pa [±0.1 "W.G.]
Air Pressure (space)	±3 Pa [±0.01 "W.G.]
Water Pressure	±2% of full scale *Note 2
Electrical Power	± 5% of reading *Note 3
Carbon Monoxide (CO)	± 5% of reading
Carbon Dioxide (CO2)	± 50 PPM

Note 1: (10%-100% of scale) (cannot read accurately below 10%)

Note 2: for both absolute and differential pressure

Note 3: * not including utility supplied meters

1.06 SUBMITTALS

A. Contractor shall provide shop drawings and manufacturers' standard specification data sheets on all hardware and software to be provided. No work may begin on any segment of this project until the Engineer and Owner have reviewed submittals for conformity with the plan and specifications. All shop drawings shall be provided to the Owner electronically as .dwg or .dxf file formats.

B. Quantities of items submitted shall be reviewed by the Engineer and Owner. Such review shall not relieve the contractor from furnishing quantities required for completion.

C. Provide the Engineer and Owner, any additional information or data which is deemed necessary to determine compliance with these specifications or which is deemed valuable in documenting the system to be installed.

D. Submit the following within 60 days of contract award:

1. A complete bill of materials of equipment to be used indicating quantity, manufacturer and model number.
2. A schedule of all control valves including the valve size, model number (including pattern and connections), flow, CV, pressure rating, and location.
3. A schedule of all control dampers. This shall include the damper size, pressure drop, manufacturer and model number.
4. Provide manufacturers cut sheets for major system components. When manufacturer's cut sheets apply to a product series rather than a specific product, the data specifically applicable to the project shall be highlighted or clearly indicated by other means. Each submitted piece of literature and drawings shall clearly reference the specification and/or drawing that the submittal is being submitted to cover. Include:
    a) Building Controllers
    b) Custom Application Controllers
    c) Application Specific Controllers
    d) Operator Interface Computer(s)
    e) Portable Operator Workstation
    f) Auxiliary Control Devices
    g) Proposed control system riser diagram showing system configuration, device locations, addresses, and cabling
    h) Detailed termination drawings showing all required field and factory terminations. Terminal numbers shall be clearly labeled
    i) Points list showing all system objects, and the proposed English language object names
    j) Sequence of operations for each system under control. This sequence shall be specific for the use of the Control System being provided for this project
    k) Color prints of proposed graphics with a list of points for display

E. Project Record Documents. Upon completion of installation submit three (3) copies of record (as-built) documents. The documents shall be submitted for approval prior to final completion and include:
1. Project Record Drawings. These shall be as-built versions of the submittal shop drawings. One set of electronic media including CAD .DWG or .DXF drawing files shall also be provided.
2. Testing and Commissioning Reports and Checklists.
3. Operating and Maintenance (O & M) Manual. These shall be as-built versions of the submittal product data. In addition to that required for the submittals, the O & M manual shall include:
    a) Names, address and 24-hour telephone numbers of Contractors installing equipment, and the control systems and service representative of each.
    b) Operators Manual with procedures of operating the control systems including logging on/off, alarm handling, producing point reports, trending data, overriding computer control, and changing set points and other variables.
    c) Programming Manual with a description of the programming language including syntax, statement descriptions including algorithms and calculations used, point database creation and modification, program creation and modification, and use of the editor.
    d) Engineering, Installation and Maintenance Manual(s) that explains how to design and install new points, panels, and other hardware; preventative maintenance and calibration procedures; how to debug hardware problems; and how to repair or replace hardware.
    e) A listing and documentation of all custom software created using the programming language including the point database. One set of magnetic media containing files of the software and database shall also be provided.
    f) One set of electronic media containing files of all color-graphic screens created for the project.
    g) Complete original issue documentation, installation, and maintenance information for all third party hardware provided including computer equipment and sensors.
    h) Complete original issue media for all software provided including operating systems, programming language, operator workstation software, and graphics software.

i) Licenses and warranty documents for all equipment and systems.

j) Recommended preventive maintenance procedures for all system components including a schedule of tasks, time between tasks, and task descriptions.

F. Training Materials: The Contractor shall provide a course outline and training material for all training classes at least six weeks prior to the first class. The Owner reserves the right to modify any or all of the training course outline and training materials. Review and approval by Owner and Engineer shall be completed at least 3 weeks prior to first class.

1.07 QUALITY ASSURANCE

A. System Installer Qualifications

1. The Installer shall have an established working relationship with the Control System Manufacturer of not less than three years.

2. The Installer shall have successfully completed Control System Manufacturer's classes on the control system. The Installer shall present for review the certification of completed training, including the hours of instruction and course outlines upon request.

3. The installer shall have an office within 90 miles of the project site and provide 24-hour response in the event of a customer call.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Factory-Mounted Components: Where control devices specified in this Section are indicated to be factory mounted on equipment, arrange for shipping of control devices to equipment manufacturer.

B. System Software: Update to latest version of software at Project completion.

1.09 COORDINATION

A. Coordinate location of thermostats, humidistats, and other exposed control sensors with plans and room details before installation.

B. Coordinate equipment with Division 28 Section "Intrusion Detection" to achieve compatibility with equipment that interfaces with that system and with building master clock.

C. Coordinate equipment with Division 28 Section "Access Control" to achieve compatibility with equipment that interfaces with that system.

D. Coordinate equipment with Division 27 Section "Clock Systems" to achieve compatibility with equipment that interfaces with that system.

E. Coordinate equipment with Division 28 Section "PLC Electronic Detention Monitoring and Control Systems" to achieve compatibility with equipment that interfaces with that system.

F. Coordinate equipment with Division 26 Section "Network Lighting Controls" to achieve compatibility with equipment that interfaces with that system.

G. Coordinate equipment with Division 28 Section "Fire Detection and Alarm" to achieve compatibility with equipment that interfaces with that system.

H. Coordinate supply of conditioned electrical branch circuits for control units and operator workstation.

I. Coordinate equipment with Division 26 Section "Electrical Power Monitoring and Control" to achieve compatibility of communication interfaces.

J. Coordinate equipment with Division 26 Section "Panelboards" to achieve compatibility with starter coils and annunciation devices.

K. Coordinate equipment with Division 26 Section "Motor-Control Centers" to achieve compatibility with motor starters and annunciation devices.

L. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03 Section "Cast-in-Place Concrete."

1.010 WARRANTY

A. Warrant all work as follows:

1. Labor & materials for control system specified shall be warranted free from defects for a period of twelve (12) months after final completion acceptance by the Owner. Control System failures during the warranty period shall be adjusted, repaired, or replaced at no charge or reduction in service to the Owner. The Contractor shall respond to the Owner's request for warranty service within 24 hours during customary business hours.

2. At the end of the final start-up/testing, if equipment and systems are operating satisfactorily to the Owner and Engineer, the Owner shall sign certificates certifying that the control system's operation has been tested and accepted in accordance with the terms of this specification. The date of Owner's acceptance shall be the start of warranty.

3. Operator workstation software, project specific software, graphics, database, and firmware updates shall be provided to the Owner at no charge during the warranty period. Written authorization by Owner must, however, be granted prior to the installation of such changes.

4. The system provider shall provide a web-accessible system and support on-line resource that provides the Owner access to a question/answer forum, graphics library, user tips, upgrades, and manufacturer training schedules.

1.011 OWNERSHIP OF PROPRIETARY MATERIAL

A. All project-developed hardware and software shall become the property of the Owner. These items include but are not limited to:

1. Project graphic images
2. Record drawings
3. Project database
4. Project-specific application programming code
5. All documentation

PART 2 - PRODUCTS

2.01 MANUFACTURERS

2.02 CONTROL SYSTEM

A. Basis of Design

B. Basis of Design

C. Approved Control System Contractors and Manufacturers:

1. Alerton

D. Control system shall consist of sensors, indicators, actuators, final control elements, interface equipment, other apparatus, and accessories to control mechanical systems.

E. Control system shall consist of sensors, indicators, actuators, final control elements, interface equipment, other apparatus, accessories, and software connected to distributed controllers operating in multiuser, multitasking environment on token-passing network and programmed to control mechanical systems. An operator workstation permits interface with the network via dynamic color graphics with each mechanical system, building floor plan, and control device depicted by point-and-click graphics.

2.03 DDC EQUIPMENT MATERIALS

A. All products used in this installation shall be new, currently under manufacture, and shall be applied in similar installations for a minimum of 2 years. The installation shall not be used as a test site for any new products unless explicitly approved by the Owner's representative in writing. Spare parts shall be available for at least 5 years after completion of this contract

B. Operator Workstation: One PC-based microcomputer(s) with minimum configuration as follows:

1. Motherboard: With 8 integrated USB 2.0 ports, integrated Intel Pro 10/100 (Ethernet), integrated audio, bios, and hardware monitoring.
2. Processor: Intel Pentium 1033 MHz.
3. Random-Access Memory: 2.0 GB.
4. Graphics: Video adapter, minimum 1600 x 1200 pixels, 256-MB video memory, with TV out.
5. Monitor: 19 inches LCD color.
6. Keyboard: QWERTY, 105 keys in ergonomic shape.
7. Hard-Disk Drive: 80 GB.
8. CD-ROM Read/Write Drive: 48x24x48.
9. Mouse: Three button, optical.
10. Uninterruptible Power Supply: 2 kVa.

11. Operating System: Microsoft Windows XP Professional with high-speed Internet access.
    a. ASHRAE 135 Compliance: Workstation shall use ASHRAE 135 protocol and communicate using ISO 8802-3 (Ethernet) datalink/physical layer protocol.
12. Printer: Color, ink-jet type as follows:
    a. Print Head: 4800 x 1200 dpi optimized color resolution.
    b. Paper Handling: Minimum of 100 sheets.
    c. Print Speed: Minimum of 17 ppm in black and 12 ppm in color.

2.04 COMMUNICATION

A. This project shall comprise of a network utilizing high-speed BACnet for communications between Building Controllers and PC Workstations. BACnet sub-networks shall be used for communications between Building Controllers, Custom Application Controllers and Application Specific Controllers.

B. The Owner will provide all communication media, connectors, repeaters, hubs, and routers necessary for the internetwork. An active 10BaseT jack will be provided adjacent to each Building Control Panel and PC Workstation for connection to this network.

C. All Building Controllers shall have a communications port for connections with the operator interfaces. This may be either a network interface node for connection to the Ethernet network or an RS-232 port for Point to Point connection.

D. Remote operator interface via a 56K baud modem shall allow for communication with any and all controllers on this network as described in the following paragraph.

E. Communications services over the internetwork shall result in operator interface and value passing that is transparent to the internetwork architecture as follows:
    1. Connection of an operator interface device to any one building controller on the internetwork will allow the operator to interface with all other building controllers as if that interface were directly connected to the other controllers. Data, status information, reports, system software, custom programs, etc., for all building controllers shall be available for viewing and editing from any one building controller on the internetwork.
    2. All database values (i.e., points, software variable, custom program variables) of any one building controller shall be readable by any other building controller on the internetwork. This value passing shall be automatically performed by a controller when a reference to a point name not located in that controller is entered into the controller's database. An operator/installer shall not be required to set up any communications services to perform internetwork value passing.

F. The time clocks in all controllers shall be automatically synchronized daily.

2.05 OPERATOR INTERFACE

A. PC based workstations as shown on the system drawings. Each workstation shall be able to access all information in the system. Workstations shall reside on the same high-speed network as the building controllers, and also be able to dial into the system.

B. Hardware. Each operator workstation shall consist of the following:
    a. Personal Computer. Furnish IBM-compatible PCs to be used as DDC system workstation. The CPU shall be a minimum of an Intel Pentium 4 or AMD Athlon 64 processor and operate at a minimum 2.2 GHz. Include a minimum 512 Megabytes of RAM, 48X CD ROM drive, 80 Gigabyte hard disk, and two-button mouse. Furnish all required serial, parallel, and network communication ports, and all cables for proper system operation. The PC shall include a minimum 17", color monitor with 1024 x 768 screen resolution.
    b. Modems. Furnish auto-dial telephone modems and associated cables as required for communication to remote buildings, and workstations. The modem shall be capable of transmitting at up to 56K baud, and communicate over voice-grade telephone lines.

C. System Software
    1. Operating System. Furnish a commercially available, concurrent multi-tasking operating system. Acceptable operating systems are Microsoft Windows XP Professional.
    2. System Graphics. The Operator Workstation software shall be graphically oriented. The system shall allow display of up to 10 graphic screens at once for comparison and monitoring of system status. Provide a method for the operator to easily move between graphic displays and change the size and location of graphic displays on the screen. The system graphics shall be able to be modified while the system is on line. An operator with the proper password level shall be able to add,

delete, or change dynamic points on a graphic. Dynamic points shall include analog and binary values, dynamic text, static text, and animation files. Graphics shall have the ability to show animation of equipment. Animation capabilities shall include the ability to show a sequence of images reflecting the position of analog outputs, such as valve or damper positions (V17). Graphics shall be capable of launching other PC applications.

3. Custom Graphics. Custom graphic files shall be created with the use of commonly available graphics packages such as Corel Paint Shop Pro. The graphics generation package shall create and modify graphics that are saved in industry standard formats such as BMP, GIF and JPEG.

4. Graphics Library. Furnish a complete library of standard HVAC equipment such as chillers, boilers, air handlers, terminals, fan coils, and unit ventilators, including 2-dimensional and 3-dimensional graphic depictions. The library shall include a minimum of 300 such files available for use by the Owner. This library shall also include standard graphical representations of equipment including fans, pumps, coils, valves, piping, dampers, and ductwork. The library shall be furnished in a file format compatible with the graphics generation package program.

5. Engineering Units. Allow for selection of the desired engineering units (i.e. Inch pound or SI) in the system. Unit selection shall be able to be customized by locality to select the desired units for each measurement. Engineering units on this project shall be Inch Pound [SI].

D. System Applications. Each workstation shall provide operator interface and off-line storage of system information. Provide the following applications at each workstation.

1. Automatic System Database Save and Restore. Each workstation shall store on the hard disk a copy of the current database of each building controller. This database shall be updated whenever a change is made in any panel in the system. The storage of this data shall be automatic and not require operator intervention. In the event of a database loss in a building management panel, the first workstation to detect the loss shall automatically restore the database for that panel.

2. Manual Database Save and Restore. A system operator with the proper password clearance shall be able to archive the database from any system panel and store on magnetic media. The operator shall also be able to clear a panel database and manually initiate a download of a specified database to any panel in the system.

3. System Configuration. The workstation software shall provide a graphical method of configuring the system. The user with proper security shall be able to add new devices, and assign modems to devices. This shall allow for future system changes or additions.

4. On-Line Help and Training. Provide a context sensitive, on line help system to assist the operator in operation and editing of the system. On-line help shall be available for all system functions and shall provide the relevant data for that particular screen. Additional help shall be available through the use of hypertext links onscreen.

5. Security. Each operator shall be required to log on to the system with a user name and password in order to view, edit, add, or delete data. System security shall be selectable for each operator. The system supervisor shall have the ability to set security levels for all other operators. Each operator password shall be able to restrict the operator's access for viewing and/or changing each system application, full screen editor, and object. Each operator shall automatically be logged off of the system if no keyboard or mouse activity is detected. This auto logoff time shall be set per operator password. All system security data shall be stored in an encrypted format.

6. System Diagnostics. The system shall automatically monitor the operation of all workstations, printers, modems, network connections, building management panels, and controllers. The failure of any device shall be annunciated to the operator.

7. Alarm Notification. Alarm messages shall use full language, easily recognized descriptors for alarm. System shall allow the user to have up to 10 popup windows appear for incoming alarms. The popup dialog shall allow the user to silence and acknowledge alarms, view an expanded message or graphic, and add and save comments for the alarm.

8. Alarm Processing. Any object in the system shall be configurable to alarm in and out of normal state. The operator shall be able to configure the alarm limits, warning limits, states, and reactions for each object in the system.

9. Alarm Reactions. The operator shall be able to determine what actions, if any, are to be taken, by object, during an alarm. Actions shall include logging, printing, start a custom control program, displaying messages, dialing out to remote workstations, paging or text message to a cell phone, forwarding to an e-mail address, providing audible annunciation or displaying specific system graphics. Each of these actions shall be configurable by workstation and time of day. An object in

alarm that has not been acknowledged within an operator specified time period shall be re-routed to an alternate operator specified alarm receipt device. For text messaging, the system shall support TAP protocol including parities 7-E-1 and 8-n-1, such that if the system fails to dial out/connect with one parity it will automatically try the other one.

10. Alarm and Event Log. The operator shall be able to view all logged system alarms and events from any location in the system. The operator shall be able to sort and filter alarms from events. Alarms shall be sorted in up to 5 color-coded categories based on Owner preference (V17). Include an alarm count summary for each alarm category on the system toolbar. An operator with the proper security level may acknowledge and clear alarms. All that have not been cleared by the operator shall be archived to the hard disk on the workstation. Provide a comment field in the event log that allows a user to add specific comments associated with any alarm.

11. Trend Logs. The operator shall be able to define a trend log for any data in the system. This definition shall include interval, start-time, and stop-time. Trend intervals of 30 seconds,1, 5, 15, 30, and 60 minutes as well as once a shift (8 hours), once a day, once a week, and once a month shall be selectable. Each trend shall accommodate up to 64 system objects. The system operator shall be able to determine how many samples are stored in each trend. Trend data shall be sampled and stored on the Building Controller panel and be archived on the workstation hard disk. Trend data shall be able to be viewed and printed from the operator interface software. Trends must be viewable in a text-based format or graphically. Trends shall also be storable in a tab delimited ASCII format for use by other industry standard word processing and spreadsheet packages.

12. Dynamic Graphical Trending. The system shall have the ability to save the data collected by a trend object and display that collected data in a graphical chart. Trend viewing capabilities shall include the ability to show up to 10 points on a chart, to include live and/or historical data. Each data point trend line shall be an individual color, and include on-graph icons that represent associated events/alarms, manual overrides, and automated changes that have occurred over the time frame represented on the chart. Navigation and viewing functions shall include scrolling and zooming of x and y axes, and a trace display of the associated time stamp, and values for any selected point along the x-axis. Trend data shall be able to be stored for up to 10 years on the PC workstation.

13. Object and Property Status and Control. Provide a method for the operator to view, and edit if applicable, the status of any object and property in the system. These statuses shall be available by menu, on graphics or through custom programs.

14. Clock Synchronization. The real time clocks in all building controllers and workstations shall be synchronized on command of an operator. The system shall also be able to automatically synchronize all system clocks; daily from any operator designated device in the system. The system shall automatically adjust for daylight savings time if applicable.

15. Reports and Logs. Provide a reporting package that allows the operator to select, modify, or create reports. Each report shall be definable as to data content, format, interval, and date. Report data shall be archived on the hard disk for historical reporting. Provide the ability for the operator to obtain real time logs of designated lists of objects. Reports and logs shall be stored on the PC hard disk in a format that is readily accessible by other standard software applications including spreadsheets and word processing. Reports and logs shall be readily printed to the system printer. The operator shall be able to designate reports that shall be printed or stored to disk at selectable intervals. Provide a means to list and access the last 10 reports viewed by the user.

    a) Custom Reports: Provide the capability for the operator to define any system data into a daily, weekly, monthly, or annual report. These reports shall be time and date stamped and shall contain a report title.

    b) Standard Reports. The following standard system reports shall be provided for this project. These reports shall be readily customized to the project by the owner.

        i. Electrical Meter Report: Provide a monthly report showing the daily electrical consumption and peak electrical demand for each building meter. Provide an annual (12 month) summary report showing the monthly electrical consumption and peak demand for each meter.

        ii. All Points in Alarm Report: Provide an on demand report showing all current alarms.

        iii. All Points in Override Report: Provide an on demand report showing all overrides in effect.

iv. Schedule Report: Provide a summary of all schedules including Holiday and Exception schedules.

v. Commissioning Report: Provide a one time report that lists all equipment with the unit configuration and present operation.

vi. Gas Meter Report: Provide a monthly report showing the daily natural gas consumption for each meter. Provide an annual (12 month) report that shows the monthly consumption for each meter.

vii. Weather Data Report: Provide a monthly report showing the daily minimum, maximum and average outdoor air temperature and the number of heating and cooling degree days for each day. Provide an annual (12 month) report showing the minimum, maximum and average outdoor air temperature for the month and the number of heating and cooling degree days for the month.

E. Workstation Applications Editors. Each PC workstation shall support dedicated screens for editing of all system applications. Provide editors for each application at the PC workstation. The applications shall be downloaded and executed at the appropriate controller panels.

1. Controller. Provide a full screen editor for each type custom application, and application specific controller that shall allow the operator to view and change the configuration, name, control parameters, and system set-points.

2. Scheduling. An editor for the scheduling application shall be provided at each workstation. Provide a monthly calendar for each schedule. Exception schedules and holidays shall be shown clearly on the calendar. Provide a method for allowing several related objects to follow a schedule. An advance and delay time for each object shall be adjustable from this master schedule. An operator shall be able to modify the schedule. Schedules shall be able to be easily copied between objects and/or dates.

3. Manual Control and Override. Provide a means of manually controlling analog and binary output points. Control overrides shall be performed through a simple, graphical on-off-auto editor for binary points, and auto-manual selector for analog control. Provide a icon indicator of override status when a point, unit controller or application has been overridden manually.

4. Air System Equipment Coordination. Provide editor screens with monitoring and control functions that group together and coordinates the operation of air handling equipment as specified in the sequence of operations. For each air system, the editor pages shall include:

a) System mode of the air handling system

b) Listing and assignment of the associated ERVs and Water Source Heat Pump (WSHP)

c) WSHP & ERVs supply air cooling and heating setpoints

d) WSHP & ERVs minimum, maximum and nominal static pressure setpoints

2.06 APPLICATION AND CONTROL SOFTWARE

A. Furnish the following applications software for building and energy management. All software applications shall reside and run in the system controllers. Editing of applications shall occur at the operator workstation.

B. System Security

1. User access shall be secured using individual security passwords and user names.

2. Passwords shall restrict the user to only the objects, applications, and system functions as assigned by the system manager.

3. User logon/logoff attempts shall be recorded.

4. The system shall protect itself from unauthorized use by automatically logging off following the last keystroke. The delay time shall be user definable.

C. Scheduling. Provide the capability to schedule each object or group of objects in the system. Each of these schedules shall include the capability for start, stop, optimal start, optimal stop, and night economizer actions. Each schedule may consist of up to [10] events. When a group of objects are scheduled together, provide the capability to define advances and delays for each member. Each schedule shall consist of the following:

1. Weekly Schedule. Provide separate schedules for each day of the week.

2. Exception Schedules. Provide the ability for the operator to designate any day of the year as an exception schedule. This exception schedule shall override the standard schedule for that day.

Exception schedules may be defined up to a year in advance. Once an exception schedule is executed it will be discarded and replaced by the standard schedule for that day of the week.

3. Holiday Schedules. Provide the capability for the operator to define up to 99 special or holiday schedules. These schedules may be placed on the scheduling calendar and will be repeated each year. The operator shall be able to define the length of each holiday period.

4. Optimal Start. The scheduling application outlined above shall support an optimal start algorithm. This shall calculate the thermal characteristics of a zone and start the equipment prior to occupancy to achieve the desired space temperature at the specified occupancy time. The algorithm shall calculate separate sets of heating and cooling rates for zones that have been unoccupied for less then and greater than 24 hours. Provide the ability to modify the start algorithm based on outdoor air temperature. Provide an early start limit in minutes to prevent the system from starting before an operator determined time limit.

D. Remote Communications. The system shall have the ability to transmit alarms to multiple associated alarm receivers. Receivers shall include PC Workstations, email addresses, cell phones and alphanumeric pagers. The alarm message shall include the name of the alarm location, the device that generated the alarm, and the alarm message itself. The operator shall be able to remotely access and operate the system utilizing the system Ethernet communications, or dial up communications via modem, in the same format and method used on site as described under the Operator Interface section of this specification.

E. PID Control. A PID (proportional-integral-derivative) algorithm with direct or reverse action and anti-wind-up shall be supplied. The algorithm shall calculate a time-varying analog value used to position an output or stage a series of outputs. The controlled variable, set-point, and PID gains shall be user-selectable. The set-point shall optionally be chosen to be a reset schedule.

F. Timed Override. A standard application shall be utilized to enable/disable temperature control when a user selects on/cancel at the zone sensor, workstation, or the operator display. The amount of time that the override takes precedence will be selectable from the workstation.

G. Staggered Start. This application shall prevent all controlled equipment from simultaneously restarting after a power outage. The order in which equipment (or groups of equipment) is started, along with the time delay between starts shall be user-selectable.

H. System Calculations. Provide software to allow instantaneous power (e.g. KW), flow rates (e.g. L/s [GPM]) to be accumulated and converted to energy usage data. Provide an algorithm that calculates a sliding-window KW demand value. Provide an algorithm that calculates energy usage and weather data (heating and cooling degree days). These items shall all be available for daily, previous day, monthly and the previous month.

I. Anti-Short Cycling. All binary output points shall be protected from short cycling. This feature shall allow minimum on-time and off-time to be selected.

2.07 BUILDING CONTROLLERS

A. General. Provide Building Controllers to provide the performance specified in section 1 of this division. Each of these panels shall meet the following requirements.

1. The Building Automation System shall be composed of one or more independent, standalone, microprocessor based Building Controllers to manage the global strategies described in System software section.

2. The Building Controller shall have sufficient memory to support its operating system, database, and programming requirements.

3. The controller shall provide a communications port for connection of the Portable Operators Terminal.

4. The operating system of the Controller shall manage the input and output communications signals to allow distributed controllers to share real and virtual point information and allow central monitoring and alarms.

5. Controllers that perform scheduling shall have a real time clock.

6. Data shall be shared between networked Building Controllers.

7. The Building Controller shall utilize industry recognized open standard protocols for communication to unit controllers.

8. The Building Controller shall continually check the status of its processor and memory circuits. If an abnormal operation is detected, the controller shall:

a) Assume a predetermined failure mode.

b) Generate an alarm notification.

c) Create a retrievable file of the state of all applicable memory locations at the time of the failure.

d) Automatically reset the Building Controller to return to a normal operating mode.

B. Communications. Each Building Controller shall reside on a BACnet internetwork using the ISO 8802-3 (Ethernet) Physical/Data Link layer protocol. Each Building Controller shall also perform routing to a network of Custom Application and Application Specific Controllers.]

C. Environment. Controller hardware shall be suitable for the anticipated ambient conditions. Controller used in conditioned ambient shall be mounted in an enclosure, and shall be rated for operation at 0 C to 50 C [32 F to 120 F].

D. Serviceability. Provide diagnostic LEDs for power, communications, and processor. The Building Controller shall have a display on the main board that indicates the current operating mode of the controller. All wiring connections shall be made to field removable, modular terminal strips or to a termination card connected by a ribbon cable. The primary logic board shall be removable without disconnecting field wiring.

E. Memory. The Building Controller shall maintain all BIOS and programming information in the event of a power loss for at least 72 hours.

F. Immunity to power and noise. Controller shall be able to operate at 90% to 110% of nominal voltage rating and shall perform an orderly shut-down below 80% nominal voltage

2.08 CUSTOM APPLICATION CONTROLLERS

A. General. Provide Custom Application Controllers to provide the performance specified in section 1 of this division. Each of these panels shall meet the following requirements.

1. The Controller shall have sufficient memory to support its operating system, database, and programming requirements.

2. Controllers that perform scheduling shall have a real time clock.

3. The operating system of the Controller shall manage the input and output communications signals to allow distributed controllers to share real and virtual point information and allow central monitoring and alarms.

4. The Controller shall continually check the status of its processor and memory circuits. If an abnormal operation is detected, the controller shall assume a predetermined failure mode, and generate an alarm notification.

B. Environment. Controller hardware shall be suitable for the anticipated ambient conditions.

1. Controller used in conditioned ambient shall be mounted in NEMA 1 type enclosures, and shall be rated for operation at 0 C to 50 C [32 F to 120 F].

2. Controllers used outdoors and/or in wet ambient shall be mounted within NEMA 4 type waterproof enclosures, and shall be rated for operation at -40 C to 70 C [-40 F to 158 F].

C. Serviceability. Provide diagnostic LEDs for power, communications, and processor. All low voltage wiring connections shall be made such that the controller electronics can be removed and/or replaced without disconnection of field termination wiring.

D. Memory. The Controller shall maintain all BIOS and programming information in the event of a power loss for at least 72 hours.

E. Immunity to power and noise. Controller shall be able to operate at 90% to 110% of nominal voltage rating and shall perform an orderly shutdown below 80% nominal voltage.

2.09 APPLICATION SPECIFIC CONTROLLERS

A. General. Application specific controllers (ASC) are microprocessor-based DDC controllers, which through hardware or firmware design are dedicated to control a specific piece of equipment. They are not fully user programmable, but are customized for operation within the confines of the equipment they are designed to serve.

1. Each ASC shall be capable of stand-alone operation and shall continue to provide control functions without being connected to the network.

2. Each ASC will contain sufficient I/O capacity to control the target system.

B. Environment. The hardware shall be suitable for the anticipated ambient conditions.

1. Controller used in conditioned ambient spaces shall be mounted in NEMA 1 type rated enclosures. Controllers located where not to be disturbed by building activity (such as above ceiling grid), may be provided with plenum-rated enclosures and non-enclosed wiring connections for plenum cabling. All controllers shall be rated for operation at 0 C to 50 C [32 F to 120 F].
2. Controllers used outdoors and/or in wet ambient shall be mounted within NEMA 4 type waterproof enclosures, and shall be rated for operation at -40 C to 65 C [-40 F to 150 F].

C. Serviceability. Provide diagnostic LEDs for power and communications. All wiring connections shall be clearly labeled and made to be field removable.

D. Memory. The Application Specific Controller shall maintain all BIOS and programming information in the event of a power loss for at least 90 days.

E. Immunity to Power and noise. Controller shall be able to operate at 90% to 110% of nominal voltage rating and shall perform an orderly shutdown below 80%.

F. Transformer. Power supply for the ASC must be rated at minimum of 125% of ASC power consumption, and shall be fused or current limiting type.

2.010 INPUT/OUTPUT INTERFACE

A. Hard-wired inputs and outputs may tie into the system through Building, Custom, or Application Specific Controllers.

B. All input points and output points shall be protected such that shorting of the point to itself, another point, or ground will cause no damage to the controller. All input and output points shall be protected from voltage up to 24V of any duration, such that contact with this voltage will cause no damage to the controller.

C. Binary inputs shall allow the monitoring of on/off signals from remote devices. The binary inputs shall provide a wetting current of at least 12 mA to be compatible with commonly available control devices.

D. Pulse accumulation input points. This type of point shall conform to all the requirements of Binary Input points, and also accept up to 3 pulses per second for pulse accumulation, and shall be protected against effects of contact bounce and noise.

E. Analog inputs shall allow the monitoring of low voltage (0-10 Vdc), current (4-20 ma), or resistance signals (thermistor, RTD). Analog inputs shall be compatible with, and field configurable to commonly available sensing devices.

F. Binary outputs shall provide for on/off operation. Terminal unit and zone control applications may use 2 outputs for drive-open, drive-close (tri-state) modulating control

G. Analog outputs shall provide a modulating signal for the control of end devices. Outputs shall provide either a 0-10 Vdc or a 4-20 ma signal as required to provide proper control of the output device

2.011 AUXILIARY CONTROL DEVICES

A. Motorized dampers, unless otherwise specified elsewhere, shall be as follows:

1. Damper frames shall be 16 gauge galvanized sheet metal or 1/8" extruded aluminum with reinforced corner bracing.
2. Damper blades shall not exceed 8" in width or 48" in length. Blades are to be suitable for medium velocity performance (2,000 fpm). Blades shall be not less than 16 gauge.
3. Damper shaft bearings shall be as recommended by manufacturer for application.
4. All blade edges and top and bottom of the frame shall be provided with compressible seals. Side seals shall be compressible stainless steel. The blade seals shall provide for a maximum leakage rate of 10 CFM per square foot at 2.5" w.c. differential pressure.
5. All leakage testing and pressure ratings will be based on AMCA Publication 500.
6. Individual damper sections shall not be larger than 48" x 60". Provide a minimum of one damper actuator per section.

B. Control dampers shall be parallel or opposed blade types as scheduled on drawings.

C. Electric damper/valve actuators.

1. The actuator shall have electronic overload or digital rotation sensing circuitry to prevent damage to the actuator throughout the rotation of the actuator.
2. Where shown, for power-failure/safety applications, an internal mechanical, spring return mechanism shall be built into the actuator housing.

3. All rotary spring return actuators shall be capable of both clockwise or counter clockwise spring return operation. Linear actuators shall spring return to the retracted position.
4. Proportional actuators shall accept a 0-10 VDC or 0-20 ma control signal and provide a 2-10 VDC or 4-20 ma operating range.
5. All non-spring return actuators shall have an external manual gear release to allow manual positioning of the damper when the actuator is not powered. Spring return actuators with more than 60 in-lb. torque capacity shall have a manual crank for this purpose.
6. Actuators shall be provided with a conduit fitting and a minimum 1m electrical cable and shall be pre-wired to eliminate the necessity of opening the actuator housing to make electrical connections.
7. Actuators shall be Underwriters Laboratories Standard 873 listed.
8. Actuators shall be designed for a minimum of 60,000 full stroke cycles at the actuator's rated torque.

D. Control Valves
1. Control valves shall be two-way or three-way type for two-position or modulating service as scheduled or shown.
2. Close-off (differential) Pressure Rating: Valve actuator and trim shall be furnished to provide the following minimum close-off pressure ratings:
   a) Water Valves:
      i. Two-way: 150% of total system (pump) head.
      ii. Three-way: 300% of pressure differential between ports A and B at design flow or 100% of total system (pump) head.
   b) Steam Valves: 150% of operating (inlet) pressure.
3. Water Valves:
   a) Body and trim style and materials shall be per manufacturer's recommendations for design conditions and service shown, with equal percentage ports for modulating service.
   b) Sizing Criteria:
      i. Two-position service: Line size.
      ii. Two-way modulating service: Pressure drop shall be equal to twice the pressure drop through heat exchanger (load), 50% of the pressure difference between supply and return mains, or [5] psi, whichever is greater.
      iii. Three-way Modulating Service: Pressure drop equal to twice the pressure drop through the coil exchanger (load), [5] psi maximum.
      iv. Valves 1/2" through 2" shall be bronze body or cast brass ANSI Class 250, spring loaded, Teflon packing, quick opening for two-position service. Two-way valves to have replaceable composition disc, or stainless steel ball.
      v. 2-1/2" valves and larger shall be cast iron ANSI Class 125 with guided plug and Teflon packing.
   c) Water valves shall fail normally open or closed as scheduled on plans or as follows:
      i. Heating coils in air handlers - normally open.
      ii. Chilled water control valves - normally closed.
      iii. Other applications - as scheduled or as required by sequence of operation.
   d) Zone valves shall be sized to meet the control application and they shall maintain their last position in the event of a power failure.

E. Binary Temperature Devices
1. Low-Voltage Space Thermostats shall be 24 V, bimetal-operated, mercury-switch type, with either adjustable or fixed anticipation heater, concealed setpoint adjustment, 13°C-30°C (55°F-85°F) setpoint range, 1°C (2°F) maximum differential, and vented cover.
2. Line-Voltage Space Thermostats shall be bimetal-actuated, open-contact type or bellows-actuated, enclosed, snap-switch type or equivalent solid-state type, with heat anticipator, UL listing for electrical rating, concealed setpoint adjustment, 13°C-30°C (55°F-85°F) setpoint range, 1°C (2°F) maximum differential, and vented cover.

3. Low-Limit airstream thermostats shall be UL listed, vapor pressure type. Element shall be at least 6 m (20 ft) long. Element shall sense temperature in each 30 cm (1 ft) section and shall respond to lowest sensed temperature. Low-limit thermostat shall be manual reset only.

F. Temperature Sensors

1. Temperature sensors shall be Resistance Temperature Device (RTD) or Thermistor.
2. Duct sensors shall be rigid or averaging as shown. Averaging sensors shall be a minimum of 1.5m [5 feet] in length.
3. Immersion sensors shall be provided with a separable stainless steel well. Pressure rating of well is to be consistent with the system pressure in which it is to be installed.
4. Space sensors shall be equipped with set-point adjustment, override switch, display, and/or communication port as shown on the drawings.
5. Provide matched temperature sensors for differential temperature measurement. Differential accuracy shall be within 0.1 C [0.2 F].
6. [Optional] The space temperature, setpoint, and override confirmation will be annunciated by a digital display for each zone sensor. The setpoint will be selectable utilizing buttons.

G. Static Pressure Sensors

1. Sensor shall have linear output signal. Zero and span shall be field-adjustable.
2. Sensor sensing elements shall withstand continuous operating conditions plus or minus 50% greater than calibrated span without damage.
3. Water pressure sensor shall have stainless steel diaphragm construction, proof pressure of 150 psi minimum. Sensor shall be complete with 4-20 ma output, required mounting brackets, and block and bleed valves. Mount in location accessible for service.
4. Water differential pressure sensor shall have stainless steel diaphragm construction, proof pressure of 150 psi minimum. Over-range limit (DP) and maximum static pressure shall be 3,000 psi. Transmitter shall be complete with 4-20 ma output, required mounting brackets, and five-valve manifold. Mount in a location accessible for service.

H. Low Limit Thermostats

1. Safety low limit thermostats shall be vapor pressure type with an element 6m [20 ft] minimum length. Element shall respond to the lowest temperature sensed by any one foot section.
2. Low limit shall be manual reset only.

I. Flow Switches

1. Flow-proving switches shall be either paddle or differential pressure type, as shown.
2. Paddle type switches (water service only) shall be UL listed, SPDT snap-acting with pilot duty rating (125 VA minimum). Adjustable sensitivity with NEMA 1 Type enclosure unless otherwise specified:
3. Differential pressure type switches (air or water service) shall be UL listed, SPDT snap-acting, pilot duty rated (125 VA minimum), NEMA 1 Type enclosure, with scale range and differential suitable for intended application, or as specified.
4. Current sensing relays may be used for flow sensing or terminal devices.

J. Relays

1. Control relays shall be UL listed plug-in type with dust cover. Contact rating, configuration, and coil voltage suitable for application.
2. Time delay relays shall be UL listed solid-state plug-in type with adjustable time delay. Delay shall be adjustable plus or minus 200% (minimum) from set-point shown on plans. Contact rating, configuration, and coil voltage suitable for application. Provide NEMA 1 Type enclosure when not installed in local control panel.

K. Transformers and Power Supplies

1. Control transformers shall be UL listed, Class 2 current-limiting type, or shall be furnished with over-current protection in both primary and secondary circuits for Class 2 service.
2. Unit output shall match the required output current and voltage requirements. Current output shall allow for a 50% safety factor. Output ripple shall be 3.0 mV maximum Peak-to-Peak. Regulation

shall be 0.10% line and load combined, with 50 microsecond response time for 50% load changes. Unit shall have built-in over-voltage protection.

3. Unit shall operate between 0 C and 50 C.

4. Unit shall be UL recognized.

L. Current Switches

1. Current-operated switches shall be self-powered, solid state with adjustable trip current. The switches shall be selected to match the current of the application and output requirements of the DDC system.

M. LOCAL CONTROL PANELS

1. All indoor control cabinets shall be fully enclosed NEMA 1 Type construction with hinged door,and removable sub-panels or electrical sub-assemblies.

2. Interconnections between internal and face-mounted devices shall be pre-wired with color-coded stranded conductors neatly installed in plastic troughs and/or tie-wrapped. Terminals for field connections shall be UL listed for 600-volt service, individually identified per control/interlock drawings, with adequate clearance for field wiring. Control terminations for field connection shall be individually identified per control drawings.

3. Provide on/off power switch with over-current protection for control power sources to each local panel.

PART 3: EXECUTION

3.01 SECTION INCLUDES:

.1 Examination
.2 Protection
.3 General Workmanship
.4 Field Quality Control
.5 Wiring
.6 Fiber Optic Cable
.7 Installation of Sensors
.8 Flow Switch Installation
.9 Actuators
.10 Warning Labels
.11 Identification of Hardware and Wiring
.12 Controllers
.13 Programming
.14 Cleaning
.15 Training
.16 Acceptance

3.02 EXAMINATION

A. The project plans shall be thoroughly examined for control device and equipment locations, and any discrepancies, conflicts, or omissions shall be reported to the Architect/Engineer for resolution before rough-in work is started.

B. The contractor shall inspect the site to verify that equipment is installable as shown, and any discrepancies, conflicts, or omissions shall be reported to the Architect/Engineer for resolution before rough-in work is started.

3.03 PROTECTION

A. The Contractor shall protect all work and material from damage by his/her work or workers, and shall be liable for all damage thus caused.

B. The Contractor shall be responsible for his/her work and equipment until finally inspected, tested, and accepted. The Contractor shall protect his/her work against theft or damage, and shall carefully store material and equipment received on site that is not immediately installed. The Contractor shall close all open ends of work with temporary covers or plugs during storage and construction to prevent entry of foreign objects.

3.04 GENERAL WORKMANSHIP

A. Install equipment, piping, wiring/conduit parallel to building lines (i.e. horizontal, vertical, and parallel to walls) wherever possible.

B. Provide sufficient slack and flexible connections to allow for vibration of piping and equipment.

C. Install all equipment in readily accessible location as defined by chapter 1 article 100 part A of the NEC. Control panels shall be attached to structural walls unless mounted in equipment enclosure specifically designed for that purpose. Panels shall be mounted to allow for unobstructed access for service.

D. Verify integrity of all wiring to ensure continuity and freedom from shorts and grounds.

E. All equipment, installation, and wiring shall comply with acceptable industry specifications and standards for performance, reliability, and compatibility and be executed in strict adherence to local codes and standard practices.

3.05 FIELD QUALITY CONTROL

A. All work, materials and equipment shall comply with the rules and regulations of applicable local, state, and federal codes and ordinances as identified in Part 1 of this Section.

B. Contractor shall continually monitor the field installation for code compliance and quality of workmanship. All visible piping and or wiring runs shall be installed parallel to building lines and properly supported.

C. Contractor shall arrange for field inspections by local and/or state authorities having jurisdiction over the work.

3.06 WIRING

A. All control and interlock wiring shall comply with the national and local electrical codes and Division 16 of these specifications. Where the requirements of this section differ with those in Division 16, the requirements of this section shall take precedence.

B. Where Class 2 wires are in concealed and accessible locations including ceiling return air plenums, approved cables not in raceway may be used provided that:

C. Circuits meet NEC Class 2 (current-limited) requirements. (Low-voltage power circuits shall be sub-fused when required to meet Class 2 current-limit.)

D. All cables shall be UL listed for application, i.e., cables used in ceiling plenums shall be UL listed specifically for that purpose.

E. Do not install Class 2 wiring in conduit containing Class 1 wiring. Boxes and panels containing high voltage may not be used for low voltage wiring except for the purpose of interfacing the two (e.g. relays and transformers).

F. Where class 2 wiring is run exposed, wiring shall be run parallel along a surface or perpendicular to it, and bundled, using approved wire ties at no greater than 3 m [10 ft] intervals. Such bundled cable shall be fastened to the structure, using specified fasteners, at 1.5 m [5 ft] intervals or more often to achieve a neat and workmanlike result.

G. All wire-to-device connections shall be made at a terminal blocks or terminal strip. All wire-to wire connections shall be at a terminal block, or with a crimped connector. All wiring within enclosures shall be neatly bundled and anchored to permit access and prevent restriction to devices and terminals.

H. Maximum allowable voltage for control wiring shall be 120V. If only higher voltages are available, the Control System Contractor shall provide step down transformers.

I. All wiring shall be installed as continuous lengths, where possible. Any required splices shall be made only within an approved junction box or other approved protective device.

J. Install plenum wiring in sleeves where it passes through walls and floors. Maintain fire rating at all penetrations in accordance with other sections of this specification and local codes.

K. Size of conduit and size and type of wire shall be the design responsibility of the Control System Contractor, in keeping with the manufacturer's recommendation and NEC.

L. Control and status relays are to be located in designated enclosures only. These relays may also be located within packaged equipment control panel enclosures. These relays shall not be located within Class 1 starter enclosures.

M. Follow manufacturer's installation recommendations for all communication and network cabling. Network or communication cabling shall be run separately from other wiring.

N. Adhere to Division 16 requirements for installation of raceway.

O. This Contractor shall terminate all control and/or interlock wiring and shall maintain updated (as-built) wiring diagrams with terminations identified at the job site.

P. Flexible metal conduits and liquid-tight, flexible metal conduits shall not exceed 3' in length and shall be supported at each end. Flexible metal conduit less than 1/2" electrical trade size shall not be used. In areas exposed to moisture, including chiller and boiler rooms, liquid-tight, flexible metal conduits shall be used.

3.07 FIBER OPTIC CABLE SYSTEM

A. All cabling shall be installed in a neat and workmanlike manner. Minimum cable and unjacketed fibber bend radii as specified by cable manufacturer shall be maintained.

B. Maximum pulling tensions as specified by the cable manufacturer shall not be exceeded during installation. Post installation residual cable tension shall be within cable manufacture's specifications.

C. Fiber optic cabinets, hardware, and cable entering the cabinet shall be installed in accordance with manufacturers' instructions. Minimum cable and unjacketed fiber bend radii as specified by cable manufacturer shall be maintained.

3.08 INSTALLATION OF SENSORS

A. Install sensors in accordance with the manufacturer's recommendations.

B. Mount sensors rigidly and adequate for the environment within which the sensor operates.

C. Room temperature sensors shall be installed on concealed junction boxes properly supported by the wall framing.

D. All wires attached to sensors shall be air sealed in their conduits or in the wall to stop air transmitted from other areas affecting sensor readings.

E. Install duct static pressure tap with tube end facing directly down-stream of air flow.

F. Sensors used in mixing plenums, and hot and cold decks shall be of the averaging type. Averaging sensors shall be installed in a serpentine manner horizontally across duct. Each bend shall be supported with a capillary clip.

G. All pipe mounted temperature sensors shall be installed in wells. Install all liquid temperature sensors with heat conducting fluid in thermal wells.

H. Wiring for space sensors shall be concealed in building walls. EMT conduit is acceptable within mechanical and service rooms.

I. Install outdoor air temperature sensors on north wall complete with sun shield at designated location.

3.09 FLOW SWITCH INSTALLATION

A. Use correct paddle for pipe diameter.

B. Install and adjust flow switch in accordance with manufacturers' instructions.

C. Assure correct flow direction and alignment.

D. Mount in horizontal piping - flow switch on top of the pipe.

3.010 ACTUATORS

A. Mount and link control damper actuators per manufacturer's instructions.

1. To compress seals when spring return actuators are used on normally closed dampers, power actuator to approximately 5° open position, manually close the damper, and then tighten the linkage.

2. Check operation of damper/actuator combination to confirm that actuator modulates damper smoothly throughout stroke to both open and closed positions.

3. Valves - Actuators shall be mounted on valves with adapters approved by the actuator manufacturer. Actuators and adapters shall be mounted following manufacturer's recommendations.

3.011 WARNING LABELS

A. Affix labels on each starter and equipment automatically controlled through the DDC System. Warning label shall indicate the following:

CAUTION This equipment is operating under automatic control and may start or stop at any time without warning. Switch disconnect to “Off” position before servicing.

B. Affix labels to motor starters and control panels that are connected to multiple power sources utilizing separate disconnects. Labels shall indicate the following:

CAUTION This equipment is fed from more than one power source with separate disconnects. Disconnect all power sources before servicing.

3.012 IDENTIFICATION OF HARDWARE AND WIRING

A. All wiring and cabling, including that within factory-fabricated panels, shall be labeled at each end within 2" of termination with a cable identifier and other descriptive information.

B. Permanently label or code each point of field terminal strips to show the instrument or item served.

C. Identify control panels with minimum 1-cm (1/2”) letters on nameplates.

D. Identify all other control components with permanent labels. Identifiers shall match record documents. All plug-in components shall be labeled such that removal of the component does not remove the label.

3.013 CONTROLLERS

A. Provide a separate Controller for each major piece of HVAC equipment. A custom application controller may control more than one system provided that all points associated with that system are assigned to the same controller. Points used for control loop reset such as outside air or space temperature are exempt from this requirement.

B. Building Controllers and Custom Application Controllers shall be selected to provide a minimum of [15%] spare I/O point capacity for each point type found at each location. If input points are not universal, [15%] of each type is required. If outputs are not universal, [15%] of each type is required. A minimum of one spare is required for each type of point used.

1. Future use of spare capacity shall require providing the field device, field wiring, points database definition, and custom software. No additional Controller boards or point modules shall be required to implement use of these spare points.

3.014 PROGRAMMING

A. Provide sufficient internal memory for the specified control sequences and trend logging. There shall be a minimum of 25% of available memory free for future use.

B. Point Naming: System point names shall be modular in design, allowing easy operator interface without the use of a written point index.

C. Software Programming

1. Provide programming for the system as written in the specifications and adhere to the sequence strategies provided. All other system programming necessary for the operation of the system but not specified in this document shall also be provided by the Control System Contractor. Imbed into any custom-written control programs sufficient comment statements or inherent flow diagrams to clearly describe each section of the program. The comment statements shall reflect the language used in the sequence of operations.

D. Operators' Interface

1. Standard Graphics. Provide graphics for each major piece of equipment and floor plan in the building. This includes each Chiller, Air Handler, VAV Terminal, Fan Coil, Boiler, and Cooling Tower. These standard graphics shall show all points dynamically as specified in the points list.
2. The controls contractor shall provide all the labor necessary to install, initialize, start-up, and trouble-shoot all operator interface software and their functions as described in this section. This includes any operating system software, the operator interface database, and any third party software installation and integration required for successful operation of the operator interface.
3. As part of this execution phase, the controls contractor will perform a complete test of the operator interface. Test duration shall be a minimum of [16] hours on-site. Tests shall be made in the presence of the Owner or Owner's representative.

E. Demonstration: A complete demonstration and readout of the capabilities of the monitoring and control system shall be performed. The contractor shall dedicate a minimum of 16 hours on-site with the Owner and his representatives for a complete functional demonstration of all the system requirements. This demonstration constitutes a joint acceptance inspection, and permits acceptance of the delivered system for on-line operation.

3.015 CLEANING

A. This contractor shall clean up all debris resulting from his or her activities daily. The contractor shall remove all cartons, containers, crates, etc. under his control as soon as their contents have been removed. Waste shall be collected and placed in a location designated by the Construction Manager or General Contractor.

B. At the completion of work in any area, the Contractor shall clean all of his/her work, equipment, etc., making it free from dust, dirt and debris, etc.

C. At the completion of work, all equipment furnished under this Section shall be checked for paint damage, and any factory finished paint that has been damaged shall be repaired to match the adjacent areas. Any metal cabinet or enclosure that has been deformed shall be replaced with new material and repainted to match the adjacent areas.

3.016 TRAINING

A. Provide a minimum of 4 classroom training sessions, 4 hours each, throughout the contract period for personnel designated by the Owner. Computer-based audio-visual training may be substituted for up to 8 hours of hands on training.

B. Train the designated staff of Owner's representative and Owner to enable them to proficiently operate the system; create, modify and delete programming; add, remove and modify physical points for the system, and perform routine diagnostic and troubleshooting procedures.

C. Additional training shall be available in courses designed to meet objectives as divided into three logical groupings; participants may attend one or more of these, depending on the level of knowledge required:

1. Day-to-day Operators
2. Advanced Operators
3. System Managers/Administrators

D. Provide course outline and materials as per Part 1 of this Section. The instructor(s) shall provide one copy of training material per student.

E. The instructor(s) shall be factory-trained instructors experienced in presenting this material.

F. Classroom training shall be done using a network of working controllers representative of the installed hardware or at the customer’s site.

G. This training shall be made available in addition to the interactive audio-visual tutorial, provided with the system.

3.017 ACCEPTANCE

A. The control systems will not be accepted as meeting the requirements of Completion until all tests described in this specification have been performed to the satisfaction of both the Engineer and Owner. Any tests that cannot be performed due to circumstances beyond the control of the Contractor may be exempt from the Completion requirements if stated as such in writing by the Owner's representative. Such tests shall then be performed as part of the warranty.

ANNEX 1: INSTRUCTIONS TO OTHER CONTRACTORS

3.018 Control Valve Installation

A. Valve submittals shall be coordinated for type, quantity, size, and piping configuration to ensure compatibility with pipe design.

B. All control valves shall be installed so that the stem position is not more than 60 degrees from the vertical up position.

C. Valves shall be installed in accordance with the manufacturer's recommendations.

D. Control valves shall be installed so that they are accessible and serviceable, and such that actuators may be serviced and removed without interference from structure or other pipes and/or equipment.

E. Isolation valves shall be installed such that control valve body may be serviced without draining the supply/return side piping system. {Note to designer: this must also be shown.} Unions shall be installed at all connections to screwed type control valves.

F. Provide tags for all control valves indicating service and number. Tags shall be brass, 1-1/2" in diameter, with 1/4" high letters. Securely fasten with chain and hook. Match identification numbers as shown on approved controls shop drawings.

ANNEX 1: INSTRUCTIONS TO OTHER CONTRACTORS

3.019 Control Damper Installation

A. Damper submittals shall be coordinated for type, quantity, and size to ensure compatibility with sheet metal design.

B. Duct openings shall be free of any obstruction or irregularities that might interfere with blade or linkage rotation or actuator mounting. Duct openings shall measure 1/4" larger than damper dimensions and shall be square, straight, and level.

C. Individual damper sections, as well as entire multiple section assemblies, must be completely square and free from racking, twisting, or bending. Measure diagonally from upper corners to opposite lower corners of each damper section. Both dimensions must be equal ±1/8".

D. Follow manufacturer's instructions for field installation of control dampers. Unless specifically designed for vertical blade application, dampers must be mounted with blade axis horizontal.

E. Install extended shaft or jackshaft per manufacturer's instructions. (Typically, a sticker on the damper face shows recommended extended shaft location. Attach shaft on labeled side of damper to that blade.)

F. Damper blades, axles, and linkage must operate without binding. Before system operation, cycle damper after installation to assure proper operation. On multiple section assemblies, all sections must open and close simultaneously.

G. Provide a visible and accessible indication of damper position on the drive shaft end.

H. Support duct-work in area of damper when required to prevent sagging due to damper weight.

I. After installation of low-leakage dampers with seals, caulk between frame and duct or opening to prevent leakage around perimeter of damper.

ANNEX 1: INSTRUCTIONS TO OTHER CONTRACTORS

3.020 Duct Smoke Detection

A. Provide complete submittal data to controls system contractor for coordination of duct smoke detector interface to HVAC systems. This contractor shall provide a dry-contact alarm output in the same room as the HVAC equipment to be controlled.

END OF SECTION 23 0900

SECTION 23 11 23
FACILITY NATURAL-GAS PIPING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes:

1. Pipes, tubes, and fittings.
2. Piping specialties.
3. Piping and tubing joining materials.
4. Valves.
5. Pressure regulators.
6. Service meters.
7. Mechanical sleeve seals.
8. Grout.
9. Concrete bases.

1.03 DEFINITIONS

A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.

B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

1.04 PERFORMANCE REQUIREMENTS

A. Minimum Operating-Pressure Ratings:

1. Piping and Valves: 100 psig minimum unless otherwise indicated.
2. Service Regulators: 65 psig minimum unless otherwise indicated.
3. Minimum Operating Pressure of Service Meter: 5 psig unless otherwise indicated.

B. Natural-Gas System Pressure within Buildings: 0.5 psig.

1.05 SUBMITTALS

A. Product Data: For each type of the following:

1. Piping specialties.
2. Corrugated, stainless-steel tubing with associated components.
3. Valves. Include pressure rating, capacity, settings, and electrical connection data of selected models.
4. Pressure regulators. Indicate pressure ratings and capacities.
5. Dielectric fittings.
6. Mechanical sleeve seals.
7. Escutcheons.

B. Shop Drawings: For facility natural-gas piping layout. Include plans, piping layout and elevations, sections, and details for fabrication of pipe anchors, hangers, supports for multiple

pipes, alignment guides, expansion joints and loops, and attachments of the same to building structure. Detail location of anchors, alignment guides, and expansion joints and loops.

1. Shop Drawing Scale: 1/4 inch per foot.
2. Detail mounting, supports, and valve arrangements for service meter assembly and pressure regulator assembly.

C. Delegated-Design Submittal: For natural-gas piping and equipment indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1. Detail fabrication and assembly of seismic restraints.
2. Design Calculations: Calculate requirements for selecting seismic restraints.

D. Coordination Drawings: Plans and details, drawn to scale, on which natural-gas piping is shown and coordinated with other installations, using input from installers of the items involved.

E. Site Survey: Plans, drawn to scale, on which natural-gas piping is shown and coordinated with other services and utilities.

F. Qualification Data: For qualified professional engineer.

G. Welding certificates.

H. Field quality-control reports.

I. Operation and Maintenance Data: For pressure regulators to include in emergency, operation, and maintenance manuals.

1.06 QUALITY ASSURANCE

A. Steel Support Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

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.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Handling Flammable Liquids: Remove and dispose of liquids from existing natural-gas piping according to requirements of authorities having jurisdiction.

B. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.

C. Store and handle pipes and tubes having factory-applied protective coatings to avoid damaging coating, and protect from direct sunlight.

D. Protect stored PE pipes and valves from direct sunlight.

1.08 PROJECT CONDITIONS

A. Perform site survey, research public utility records, and verify existing utility locations. Contact utility-locating service for area where Project is located.

B. Interruption of Existing Natural-Gas Service: Do not interrupt natural-gas service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide purging and startup of natural-gas supply according to requirements indicated:

1. Notify Architect no fewer than two days in advance of proposed interruption of natural-gas service.
2. Do not proceed with interruption of natural-gas service without Architect's written permission.

1.09 COORDINATION

A. Coordinate sizes and locations of concrete bases with actual equipment provided.

B. Coordinate requirements for access panels and doors for valves installed concealed behind finished surfaces. Comply with requirements in Division 08 Section "Access Doors and Frames."

PART 2 - PRODUCTS

2.01 PIPES, TUBES, AND FITTINGS

A. Steel Pipe: ASTM A 53/A 53M, black steel, Schedule 40, Type E or S, Grade B.

1. Malleable-Iron Threaded Fittings: ASME B16.3, Class 150, standard pattern.
2. Wrought-Steel Welding Fittings: ASTM A 234/A 234M for butt welding and socket welding.
3. Unions: ASME B16.39, Class 150, malleable iron with brass-to-iron seat, ground joint, and threaded ends.
4. Forged-Steel Flanges and Flanged Fittings: ASME B16.5, minimum Class 150, including bolts, nuts, and gaskets of the following material group, end connections, and facings:
    a. Material Group: 1.1.
    b. End Connections: Threaded or butt welding to match pipe.
    c. Lapped Face: Not permitted underground.
    d. Gasket Materials: ASME B16.20, metallic, flat, asbestos free, aluminum o-rings, and spiral-wound metal gaskets.
    e. Bolts and Nuts: ASME B18.2.1, carbon steel aboveground and stainless steel underground.
5. Protective Coating for Underground Piping: Factory-applied, three-layer coating of epoxy, adhesive, and PE.
    a. Joint Cover Kits: Epoxy paint, adhesive, and heat-shrink PE sleeves.
6. Mechanical Couplings:
    a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
        1) Dresser Piping Specialties; Division of Dresser, Inc.
        2) Smith-Blair, Inc.
    b. Steel flanges and tube with epoxy finish.
    c. Buna-nitrile seals.
    d. Steel bolts, washers, and nuts.
    e. Coupling shall be capable of joining PE pipe to PE pipe, steel pipe to PE pipe, or steel pipe to steel pipe.
    f. Steel body couplings installed underground on plastic pipe shall be factory equipped with anode.

2.02 PIPING SPECIALTIES

A. Appliance Flexible Connectors:

1. Indoor, Fixed-Appliance Flexible Connectors: Comply with ANSI Z21.24.
2. Indoor, Movable-Appliance Flexible Connectors: Comply with ANSI Z21.69.
3. Outdoor, Appliance Flexible Connectors: Comply with ANSI Z21.75.
4. Corrugated stainless-steel tubing with polymer coating.
5. Operating-Pressure Rating: 0.5 psig.

6. End Fittings: Zinc-coated steel.
7. Threaded Ends: Comply with ASME B1.20.1.
8. Maximum Length: 72 inches.

B. Quick-Disconnect Devices: Comply with ANSI Z21.41.
1. Copper-alloy convenience outlet and matching plug connector.
2. Nitrile seals.
3. Hand operated with automatic shutoff when disconnected.
4. For indoor or outdoor applications.
5. Adjustable, retractable restraining cable.

C. Y-Pattern Strainers:
1. Body: ASTM A 126, Class B, cast iron with bolted cover and bottom drain connection.
2. End Connections: Threaded ends for NPS 2 and smaller; flanged ends for NPS 2-1/2 and larger.
3. Strainer Screen: 40-mesh startup strainer, and perforated stainless-steel basket with 50 percent free area.
4. CWP Rating: 125 psig.

D. Basket Strainers:
1. Body: ASTM A 126, Class B, high-tensile cast iron with bolted cover and bottom drain connection.
2. End Connections: Threaded ends for NPS 2 and smaller; flanged ends for NPS 2-1/2 and larger.
3. Strainer Screen: 40-mesh startup strainer, and perforated stainless-steel basket with 50 percent free area.
4. CWP Rating: 125 psig .

E. T-Pattern Strainers:
1. Body: Ductile or malleable iron with removable access coupling and end cap for strainer maintenance.
2. End Connections: Grooved ends.
3. Strainer Screen: 40-mesh startup strainer, and perforated stainless-steel basket with 57 percent free area.
4. CWP Rating: 750 psig .

F. Weatherproof Vent Cap: Cast- or malleable-iron increaser fitting with corrosion-resistant wire screen, with free area at least equal to cross-sectional area of connecting pipe and threaded-end connection.

2.03 JOINING MATERIALS

A. Joint Compound and Tape: Suitable for natural gas.

B. Welding Filler Metals: Comply with AWS D10.12/D10.12M for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

C. Brazing Filler Metals: Alloy with melting point greater than 1000 deg F complying with AWS A5.8/A5.8M. Brazing alloys containing more than 0.05 percent phosphorus are prohibited.

2.04 MANUAL GAS SHUTOFF VALVES

A. See "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles for where each valve type is applied in various services.

B. General Requirements for Metallic Valves, NPS 2 and Smaller: Comply with ASME B16.33.

1. CWP Rating: 125 psig.
2. Threaded Ends: Comply with ASME B1.20.1.
3. Dryseal Threads on Flare Ends: Comply with ASME B1.20.3.
4. Tamperproof Feature: Locking feature for valves indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
5. Listing: Listed and labeled by an NRTL acceptable to authorities having jurisdiction for valves 1 inch and smaller.
6. Service Mark: Valves 1-1/4 inches to NPS 2 shall have initials "WOG" permanently marked on valve body.

C. General Requirements for Metallic Valves, NPS 2-1/2 and Larger: Comply with ASME B16.38.
1. CWP Rating: 125 psig.
2. Flanged Ends: Comply with ASME B16.5 for steel flanges.
3. Tamperproof Feature: Locking feature for valves indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
4. Service Mark: Initials "WOG" shall be permanently marked on valve body.

D. One-Piece, Bronze Ball Valve with Bronze Trim: MSS SP-110.
1. Manufacturers: Subject to compliance with requirements, [provide products by one of the following] [available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:
   a. BrassCraft Manufacturing Company; a Masco company.
   b. Conbraco Industries, Inc.; Apollo Div.
   c. Lyall, R. W. & Company, Inc.
   d. McDonald, A. Y. Mfg. Co.
   e. Perfection Corporation; a subsidiary of American Meter Company.
2. Body: Bronze, complying with ASTM B 584.
3. Ball: Chrome-plated brass.
4. Stem: Bronze; blowout proof.
5. Seats: Reinforced TFE; blowout proof.
6. Packing: Separate packnut with adjustable-stem packing threaded ends.
7. Ends: Threaded, flared, or socket as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
8. CWP Rating: 600 psig.
9. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
10. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

2.05 PRESSURE REGULATORS

A. General Requirements:
1. Single stage and suitable for natural gas.
2. Steel jacket and corrosion-resistant components.
3. Elevation compensator.
4. End Connections: Threaded for regulators NPS 2 and smaller; flanged for regulators NPS 2-1/2 and larger.

B. Service Pressure Regulators: Comply with ANSI Z21.80.

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 on Drawings or comparable product by one of the following:
    a. Actaris.
    b. American Meter Company.
    c. Fisher Control Valves and Regulators; Division of Emerson Process Management.
    d. Invensys.
    e. Richards Industries; Jordan Valve Div.
3. Body and Diaphragm Case: Cast iron or die-cast aluminum.
4. Springs: Zinc-plated steel; interchangeable.
5. Diaphragm Plate: Zinc-plated steel.
6. Seat Disc: Nitrile rubber resistant to gas impurities, abrasion, and deformation at the valve port.
7. Orifice: Aluminum; interchangeable.
8. Seal Plug: Ultraviolet-stabilized, mineral-filled nylon.
9. Single-port, self-contained regulator with orifice no larger than required at maximum pressure inlet, and no pressure sensing piping external to the regulator.
10. Pressure regulator shall maintain discharge pressure setting downstream, and not exceed 150 percent of design discharge pressure at shutoff.
11. Overpressure Protection Device: Factory mounted on pressure regulator.
12. Atmospheric Vent: Factory- or field-installed, stainless-steel screen in opening if not connected to vent piping.
13. Maximum Inlet Pressure: 100 psig.

C. Appliance Pressure Regulators: Comply with ANSI Z21.18.

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 on Drawings or comparable product by one of the following:
    a. Canadian Meter Company Inc.
    b. Eaton Corporation; Controls Div.
    c. Harper Wyman Co.
    d. Maxitrol Company.
    e. SCP, Inc.
3. Body and Diaphragm Case: Die-cast aluminum.
4. Springs: Zinc-plated steel; interchangeable.
5. Diaphragm Plate: Zinc-plated steel.
6. Seat Disc: Nitrile rubber.
7. Seal Plug: Ultraviolet-stabilized, mineral-filled nylon.
8. Factory-Applied Finish: Minimum three-layer polyester and polyurethane paint finish.
9. Regulator may include vent limiting device, instead of vent connection, if approved by authorities having jurisdiction.
10. Maximum Inlet Pressure: 1 psig.

2.06 DIELECTRIC FITTINGS

A. Dielectric Unions:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    a. Capitol Manufacturing Company.
    b. Central Plastics Company.
    c. Hart Industries International, Inc.
    d. McDonald, A. Y. Mfg. Co.
    e. Watts Regulator Co.; Division of Watts Water Technologies, Inc.
    f. Wilkins; Zurn Plumbing Products Group.
2. Minimum Operating-Pressure Rating: 150 psig.
3. Combination fitting of copper alloy and ferrous materials.
4. Insulating materials suitable for natural gas.
5. Combination fitting of copper alloy and ferrous materials with threaded, brazed-joint, plain, or welded end connections that match piping system materials.

2.07 SLEEVES

A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.

B. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

2.08 MECHANICAL SLEEVE SEALS

A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    a. Advance Products & Systems, Inc.
    b. Calpico Inc.
    c. Metraflex Company (The).
    d. Pipeline Seal and Insulator, Inc.
2. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe and sleeve.
3. Pressure Plates: Carbon steel.
4. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one nut and bolt for each sealing element.

2.09 ESCUTCHEONS

A. General Requirements for Escutcheons: Manufactured wall and ceiling escutcheons and floor plates, with ID to fit around pipe or tube, and OD that completely covers opening.

2.010 GROUT

A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.

1. Characteristics: Post-hardening, volume adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
2. Design Mix: 5000-psi, 28-day compressive strength.
3. Packaging: Premixed and factory packaged.

2.011 LABELING AND IDENTIFYING

A. Detectable Warning Tape: Acid- and alkali-resistant, PE film warning tape manufactured for marking and identifying underground utilities, a minimum of 6 inches wide and 4 mils thick, continuously inscribed with a description of utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches deep; colored yellow.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine roughing-in for natural-gas piping system to verify actual locations of piping connections before equipment installation.

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

3.02 PREPARATION

A. Close equipment shutoff valves before turning off natural gas to premises or piping section.

B. Inspect natural-gas piping according to UPC to determine that natural-gas utilization devices are turned off in piping section affected.

C. Comply with UPC requirements for prevention of accidental ignition.

3.03 OUTDOOR PIPING INSTALLATION

A. Comply with UPC for installation and purging of natural-gas piping.

B. Install underground, natural-gas piping buried at least 36 inches below finished grade. Comply with requirements in Division 31 Section "Earth Moving" for excavating, trenching, and backfilling.

1. If natural-gas piping is installed less than 36 inches below finished grade, install it in containment conduit.

C. Install underground, PE, natural-gas piping according to ASTM D 2774.

D. Steel Piping with Protective Coating:

1. Apply joint cover kits to pipe after joining to cover, seal, and protect joints.
2. Repair damage to PE coating on pipe as recommended in writing by protective coating manufacturer.
3. Replace pipe having damaged PE coating with new pipe.

E. Copper Tubing with Protective Coating:

1. Apply joint cover kits over tubing to cover, seal, and protect joints.
2. Repair damage to PE coating on pipe as recommended in writing by protective coating manufacturer.

F. Install fittings for changes in direction and branch connections.

G. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using 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.

1. Install steel pipe for sleeves smaller than 6 inches in diameter.
2. Install cast-iron "wall pipes" for sleeves 6 inches and larger in diameter.

H. Underground, Exterior-Wall Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

I. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

J. Install pressure gage downstream from each service regulator. Pressure gages are specified in Division 23 Section "Meters and Gages for HVAC Piping."

3.04 INDOOR PIPING INSTALLATION

A. Comply with UPC for installation and purging of natural-gas piping.

B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

C. Arrange for pipe spaces, chases, slots, sleeves, and openings in building structure during progress of construction, to allow for mechanical installations.

D. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

E. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

F. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

G. Locate valves for easy access.

H. Install natural-gas piping at uniform grade of 2 percent down toward drip and sediment traps.

I. Install piping free of sags and bends.

J. Install fittings for changes in direction and branch connections.

K. Install escutcheons at penetrations of interior walls, ceilings, and floors.

1. New Piping:
    a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
    b. Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
    c. Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, stamped-steel type.
    d. Piping at Ceiling Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
    e. Piping at Ceiling Penetrations in Finished Spaces: One-piece, stamped-steel type.

L. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements in Division 07 Section "Penetration Firestopping."

M. Verify final equipment locations for roughing-in.

N. Comply with requirements in Sections specifying gas-fired appliances and equipment for roughing-in requirements.

O. Drips and Sediment Traps: Install drips at points where condensate may collect, including service-meter outlets. Locate where accessible to permit cleaning and emptying. Do not install where condensate is subject to freezing.

1. Construct drips and sediment traps using tee fitting with bottom outlet plugged or capped. Use nipple a minimum length of 3 pipe diameters, but not less than 3 inches long and same size as connected pipe. Install with space below bottom of drip to remove plug or cap.

P. Extend relief vent connections for service regulators, line regulators, and overpressure protection devices to outdoors and terminate with weatherproof vent cap.

Q. 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.

R. Concealed Location Installations: Except as specified below, install concealed natural-gas piping and piping installed under the building in containment conduit constructed of steel pipe with welded joints as described in Part 2. Install a vent pipe from containment conduit to outdoors and terminate with weatherproof vent cap.

1. Above Accessible Ceilings: Natural-gas piping, fittings, valves, and regulators may be installed in accessible spaces without containment conduit.
2. In Floors: Install natural-gas piping with welded or brazed joints and protective coating in cast-in-place concrete floors. Cover piping to be cast in concrete slabs with minimum of 1-1/2 inches of concrete. Piping may not be in physical contact with other metallic structures such as reinforcing rods or electrically neutral conductors. Do not embed piping in concrete slabs containing quick-set additives or cinder aggregate.
3. In Floor Channels: Install natural-gas piping in floor channels. Channels must have cover and be open to space above cover for ventilation.
4. In Walls or Partitions: Protect tubing installed inside partitions or hollow walls from physical damage using steel striker barriers at rigid supports.
    a. Exception: Tubing passing through partitions or walls does not require striker barriers.
5. Prohibited Locations:
    a. Do not install natural-gas piping in or through circulating air ducts, clothes or trash chutes, chimneys or gas vents (flues), ventilating ducts, or dumbwaiter or elevator shafts.
    b. Do not install natural-gas piping in solid walls or partitions.

S. Use eccentric reducer fittings to make reductions in pipe sizes. Install fittings with level side down.

T. Connect branch piping from top or side of horizontal piping.

U. Install unions in pipes NPS 2 and smaller, adjacent to each valve, at final connection to each piece of equipment. Unions are not required at flanged connections.

V. Do not use natural-gas piping as grounding electrode.

W. Install strainer on inlet of each line-pressure regulator and automatic or electrically operated valve.

X. Install pressure gage downstream from each line regulator. Pressure gages are specified in Division 23 Section "Meters and Gages for HVAC Piping."

3.05 VALVE INSTALLATION

A. Install manual gas shutoff valve for each gas appliance ahead of corrugated stainless-steel tubing, aluminum, or copper connector.

B. Install underground valves with valve boxes.

C. Install regulators and overpressure protection devices with maintenance access space adequate for servicing and testing.

D. Install earthquake valves aboveground outside buildings according to listing.

E. Install anode for metallic valves in underground PE piping.

3.06 PIPING JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs.

B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

C. Threaded Joints:

1. Thread pipe with tapered pipe threads complying with ASME B1.20.1.
2. Cut threads full and clean using sharp dies.

3. Ream threaded pipe ends to remove burrs and restore full inside diameter of pipe.
4. Apply appropriate tape or thread compound to external pipe threads unless dryseal threading is specified.
5. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

D. Welded Joints:
1. Construct joints according to AWS D10.12/D10.12M, using qualified processes and welding operators.
2. Bevel plain ends of steel pipe.
3. Patch factory-applied protective coating as recommended by manufacturer at field welds and where damage to coating occurs during construction.

E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter.

F. Flanged Joints: Install gasket material, size, type, and thickness appropriate for natural-gas service. Install gasket concentrically positioned.

G. Flared Joints: Cut tubing with roll cutting tool. Flare tube end with tool to result in flare dimensions complying with SAE J513. Tighten finger tight, then use wrench. Do not overtighten.

H. PE Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657.
1. Plain-End Pipe and Fittings: Use butt fusion.
2. Plain-End Pipe and Socket Fittings: Use socket fusion.

3.07 HANGER AND SUPPORT INSTALLATION

A. Install seismic restraints on piping. Comply with requirements for seismic-restraint devices specified in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."

B. Comply with requirements for pipe hangers and supports specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment."

C. Install hangers for horizontal steel piping with the following maximum spacing and minimum rod sizes:
1. NPS 1 and Smaller: Maximum span, 96 inches minimum rod size, 3/8 inch.
2. NPS 1-1/4: Maximum span, 108 inches; minimum rod size, 3/8 inch.
3. NPS 1-1/2 and NPS 2: Maximum span, 108 inches; minimum rod size, 3/8 inch.
4. NPS 2-1/2 to NPS 3-1/2: Maximum span, 10 feet; minimum rod size, 1/2 inch.

3.08 CONNECTIONS

A. Connect to utility's gas main according to utility's procedures and requirements.

B. Install natural-gas piping electrically continuous, and bonded to gas appliance equipment grounding conductor of the circuit powering the appliance according to NFPA 70.

C. Install piping adjacent to appliances to allow service and maintenance of appliances.

D. Connect piping to appliances using manual gas shutoff valves and unions. Install valve within 72 inches of each gas-fired appliance and equipment. Install union between valve and appliances or equipment.

E. Sediment Traps: Install tee fitting with capped nipple in bottom to form drip, as close as practical to inlet of each appliance.

3.09 LABELING AND IDENTIFYING

A. Comply with requirements in Division 23 Section "Identification for HVAC Piping and Equipment" for piping and valve identification.

B. Install detectable warning tape directly above gas piping, 12 inches below finished grade, except 6 inches below subgrade under pavements and slabs.

3.010 PAINTING

A. Comply with requirements in Division 09 painting Sections for painting interior and exterior natural-gas piping.

B. Paint exposed, exterior metal piping, valves, service regulators, service meters and meter bars, earthquake valves, and piping specialties, except components, with factory-applied paint or protective coating.

1. Alkyd System: MPI EXT 5.1D.
    a. Prime Coat: Alkyd anticorrosive metal primer.
    b. Intermediate Coat: Exterior alkyd enamel matching topcoat.
    c. Topcoat: Exterior alkyd enamel flat.
    d. Color: Gray.

C. Paint exposed, interior metal piping, valves, service regulators, service meters and meter bars, earthquake valves, and piping specialties, except components, with factory-applied paint or protective coating.

1. Latex Over Alkyd Primer System: MPI INT 5.1Q.
    a. Prime Coat: Alkyd anticorrosive metal primer.
    b. Intermediate Coat: Interior latex matching topcoat.
    c. Topcoat: Interior latex flat.
    d. Color: Gray.

D. Damage and Touchup: Repair marred and damaged factory-applied finishes with materials and by procedures to match original factory finish.

3.011 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:

1. Test, inspect, and purge natural gas according to UPC and authorities having jurisdiction.

C. Natural-gas piping will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

3.012 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain earthquake valves.

3.013 OUTDOOR PIPING SCHEDULE

A. Underground natural-gas piping shall be one of the following:

1. PE pipe and fittings joined by heat fusion, or mechanical couplings; service-line risers with tracer wire terminated in an accessible location.
2. Steel pipe with wrought-steel fittings and welded joints, or mechanical couplings. Coat pipe and fittings with protective coating for steel piping.

B. Aboveground natural-gas piping shall be one of the following:

1. Steel pipe with malleable-iron fittings and threaded joints.
2. Steel pipe with wrought-steel fittings and welded joints.

3.014 INDOOR PIPING SCHEDULE FOR SYSTEM PRESSURES LESS THAN 0.5 PSIG

A. Aboveground, branch piping NPS 1 and smaller shall be the following:

1. Corrugated stainless-steel tubing with mechanical fittings having socket or threaded ends to match adjacent piping.
2. Annealed-temper, tin-lined copper tube with flared joints and fittings.

B. Aboveground, distribution piping shall be one of the following:

1. Steel pipe with malleable-iron fittings and threaded joints.
2. Steel pipe with wrought-steel fittings and welded joints.
3. Drawn-temper copper tube with wrought-copper fittings and brazed joints.

C. Underground, below building, piping shall be one of the following:

1. Steel pipe with malleable-iron fittings and threaded joints.
2. Steel pipe with wrought-steel fittings and welded joints.

D. Containment Conduit: Steel pipe with wrought-steel fittings and welded joints. Coat pipe and fittings with protective coating for steel piping.

E. Containment Conduit Vent Piping: Steel pipe with malleable-iron fittings and threaded or wrought-steel fittings with welded joints. Coat underground pipe and fittings with protective coating for steel piping.

END OF SECTION 23 11 23

SECTION 23 3113

DUCTWORK

PART 1 - GENERAL

All suspended piping and equipment shall be supported from the structure. Hangers and supports shall not be suspended from roof deck.

1.01 SUMMARY

A. Section Includes:

1. Rectangular ducts and fittings.
2. Round ducts and fittings.
3. Sheet metal materials.
4. Duct liner.
5. Sealants and gaskets.
6. Hangers and supports.

B. Related Sections:

1. Division 23 Section "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing requirements for metal ducts.
2. Division 23 Section "Air Duct Accessories" for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, and flexible ducts.

1.02 PERFORMANCE REQUIREMENTS

A. Delegated Duct Design: Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, shall comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and performance requirements and design criteria indicated in "Duct Schedule" Article.

B. Structural Performance: Duct hangers and supports and seismic restraints shall withstand the effects of gravity and seismic loads and stresses within limits and under conditions described in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and SMACNA's "Seismic Restraint Manual: Guidelines for Mechanical Systems.".

1. Seismic Hazard Level A: Seismic force to weight ratio, 0.48.
2. Seismic Hazard Level B: Seismic force to weight ratio, 0.30.
3. Seismic Hazard Level C: Seismic force to weight ratio, 0.15.

C. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1-2004.

1.03 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings:

1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
2. Factory- and shop-fabricated ducts and fittings.
3. Duct layout indicating sizes, configuration, liner material, and static-pressure classes.
4. Elevation of top of ducts.
5. Dimensions of main duct runs from building grid lines.
6. Fittings.
7. Reinforcement and spacing.
8. Seam and joint construction.
9. Penetrations through fire-rated and other partitions.
10. Equipment installation based on equipment being used on Project.
11. Locations for duct accessories, including dampers, turning vanes, and access doors and panels.

12. Hangers and supports, including methods for duct and building attachment , seismic restraints, and vibration isolation.

C. Coordination Drawings: Plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Duct installation in congested spaces, indicating coordination with general construction, building components, and other building services. Indicate proposed changes to duct layout.
2. Suspended ceiling components.
3. Structural members to which duct will be attached.
4. Size and location of initial access modules for acoustical tile.
5. Penetrations of smoke barriers and fire-rated construction.
6. Items penetrating finished ceiling including the following:
    a. Lighting fixtures.
    b. Air outlets and inlets.
    c. Speakers.
    d. Sprinklers.
    e. Access panels.
    f. Perimeter moldings.

PART 2 - PRODUCTS

2.01 RECTANGULAR DUCTS AND FITTINGS

A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.

B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 1-4, "Transverse (Girth) Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 1-5, "Longitudinal Seams - Rectangular Ducts," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

D. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 2, "Fittings and Other Construction," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.02 ROUND DUCTS AND FITTINGS

A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    a. Lindab Inc.
    b. McGill AirFlow LLC.
    c. SEMCO Incorporated.
    d. Sheet Metal Connectors, Inc.
    e. Spiral Manufacturing Co., Inc.

B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Transverse Joints - Round Duct," for static-pressure class,

applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

1. Transverse Joints in Ducts Larger Than 60 Inches (1524 mm): Flanged.

C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Seams - Round Duct and Fittings," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

D. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "90 Degree Tees and Laterals," and Figure 3-5, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.03 SHEET METAL MATERIALS

A. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

B. Exposed Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.

1. Galvanized Coating Designation: G60 (Z180)
2. Finishes for Surfaces Exposed to View: Mill phosphatized.

C. Carbon-Steel Sheets: Comply with ASTM A 1008/A 1008M, with oiled, matte finish for exposed ducts.

D. Stainless-Steel Sheets: Comply with ASTM A 480/A 480M, Type 304 or 316, as indicated in the "Duct Schedule" Article; cold rolled, annealed, sheet. Exposed surface finish shall be No. 2B, No. 2D, No. 3, or No. 4 as indicated in the "Duct Schedule" Article.

E. Aluminum Sheets: Comply with ASTM B 209 (ASTM B 209M) Alloy 3003, H14 temper; with mill finish for concealed ducts, and standard, one-side bright finish for duct surfaces exposed to view.

F. Reinforcement Shapes and Plates: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

1. Where black- and galvanized-steel shapes and plates are used to reinforce aluminum ducts, isolate the different metals with butyl rubber, neoprene, or EPDM gasket materials.

G. Tie Rods: Galvanized steel, 1/4-inch (6-mm) minimum diameter for lengths 36 inches (900 mm) or less; 3/8-inch (10-mm) minimum diameter for lengths longer than 36 inches (900 mm).

2.04 DUCT LINER

A. Fibrous-Glass Duct Liner: Comply with ASTM C 1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. CertainTeed Corporation; Insulation Group.
   b. Johns Manville.
   c. Knauf Insulation.
   d. Owens Corning.
2. Maximum Thermal Conductivity:
   a. Type I, Flexible: 0.27 Btu x in./h x sq. ft. x deg F (0.039 W/m x K) at 75 deg F (24 deg C) mean temperature.
   b. Type II, Rigid: 0.23 Btu x in./h x sq. ft. x deg F (0.033 W/m x K) at 75 deg F (24 deg C) mean temperature.
3. Antimicrobial Erosion-Resistant Coating: Apply to the surface of the liner that will form the interior surface of the duct to act as a moisture repellent and erosion-resistant coating. Antimicrobial compound shall be tested for efficacy by an NRTL and registered by the EPA for use in HVAC systems.

4. Water-Based Liner Adhesive: Comply with NFPA 90A or NFPA 90B and with ASTM C 916.
    a. For indoor applications, use adhesive that has a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. Insulation Pins and Washers:
1. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.135-inch- (3.5-mm-) diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch (38-mm) galvanized carbon-steel washer.
2. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- (0.41-mm-) thick galvanized steel; with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches (38 mm) in diameter.

C. Shop Application of Duct Liner: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-19, "Flexible Duct Liner Installation."
1. Adhere a single layer of indicated thickness of duct liner with at least 90 percent adhesive coverage at liner contact surface area. Attaining indicated thickness with multiple layers of duct liner is prohibited.
2. Apply adhesive to transverse edges of liner facing upstream that do not receive metal nosing.
3. Butt transverse joints without gaps, and coat joint with adhesive.
4. Fold and compress liner in corners of rectangular ducts or cut and fit to ensure butted-edge overlapping.
5. Do not apply liner in rectangular ducts with longitudinal joints, except at corners of ducts, unless duct size and dimensions of standard liner make longitudinal joints necessary.
6. Apply adhesive coating on longitudinal seams in ducts with air velocity of 2500 fpm (12.7 m/s).
7. Secure liner with mechanical fasteners 4 inches (100 mm) from corners and at intervals not exceeding 12 inches (300 mm) transversely; at 3 inches (75 mm) from transverse joints and at intervals not exceeding 18 inches (450 mm) longitudinally.
8. Secure transversely oriented liner edges facing the airstream with metal nosings that have either channel or "Z" profiles or are integrally formed from duct wall. Fabricate edge facings at the following locations:
    a. Fan discharges.
    b. Intervals of lined duct preceding unlined duct.
    c. Upstream edges of transverse joints in ducts where air velocities are higher than 2500 fpm (12.7 m/s) or where indicated.
9. Secure insulation between perforated sheet metal inner duct of same thickness as specified for outer shell. Use mechanical fasteners that maintain inner duct at uniform distance from outer shell without compressing insulation.
    a. Sheet Metal Inner Duct Perforations: 3/32-inch (2.4-mm) diameter, with an overall open area of 23 percent.
10. Terminate inner ducts with buildouts attached to fire-damper sleeves, dampers, turning vane assemblies, or other devices. Fabricated buildouts (metal hat sections) or other buildout means are optional; when used, secure buildouts to duct walls with bolts, screws, rivets, or welds.

2.05 SEALANT AND GASKETS

A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.

B. Two-Part Tape Sealing System:
1. Tape: Woven cotton fiber impregnated with mineral gypsum and modified acrylic/silicone activator to react exothermically with tape to form hard, durable, airtight seal.
2. Tape Width: 3 inches (76 mm)
3. Sealant: Modified styrene acrylic.
4. Water resistant.

5. Mold and mildew resistant.
6. Maximum Static-Pressure Class: 10-inch wg (2500 Pa), positive and negative.
7. Service: Indoor and outdoor.
8. Service Temperature: Minus 40 to plus 200 deg F (Minus 40 to plus 93 deg C).
9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum.
10. For indoor applications, use sealant that has a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

C. Water-Based Joint and Seam Sealant:
1. Application Method: Brush on.
2. Solids Content: Minimum 65 percent.
3. Shore A Hardness: Minimum 20.
4. Water resistant.
5. Mold and mildew resistant.
6. VOC: Maximum 75 g/L (less water).
7. Maximum Static-Pressure Class: 10-inch wg (2500 Pa), positive and negative.
8. Service: Indoor or outdoor.
9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.

D. Flanged Joint Sealant: Comply with ASTM C 920.
1. General: Single-component, acid-curing, silicone, elastomeric.
2. Type: S.
3. Grade: NS.
4. Class: 25.
5. Use: O.
6. For indoor applications, use sealant that has a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

E. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.

F. Round Duct Joint O-Ring Seals:
1. Seal shall provide maximum leakage class of 3 cfm/100 sq. ft. at 1-inch wg (0.14 L/s per sq. m at 250 Pa) and shall be rated for 10-inch wg (2500-Pa) static-pressure class, positive or negative.
2. EPDM O-ring to seal in concave bead in coupling or fitting spigot.
3. Double-lipped, EPDM O-ring seal, mechanically fastened to factory-fabricated couplings and fitting spigots.

2.06 HANGERS AND SUPPORTS

A. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.

B. Hanger Rods for Corrosive Environments: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.

C. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 4-1 (Table 4-1M), "Rectangular Duct Hangers Minimum Size," and Table 4-2, "Minimum Hanger Sizes for Round Duct."

D. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.

E. Steel Cables for Stainless-Steel Ducts: Stainless steel complying with ASTM A 492.

F. Steel Cable End Connections: Cadmium-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.

G. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.

H. Trapeze and Riser Supports:

1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.
2. Supports for Stainless-Steel Ducts: Stainless-steel shapes and plates.
3. Supports for Aluminum Ducts: Aluminum or galvanized steel coated with zinc chromate.

2.07 SEISMIC-RESTRAINT DEVICES – SEISMIC ZONE A

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Cooper B-Line, Inc.; a division of Cooper Industries.
2. Ductmate Industries, Inc.
3. Hilti Corp.
4. Kinetics Noise Control.
5. Loos & Co.; Cableware Division.
6. Mason Industries.
7. TOLCO; a brand of NIBCO INC.
8. Unistrut Corporation; Tyco International, Ltd.

B. General Requirements for Restraint Components: Rated strengths, features, and applications shall be as defined in reports by an agency acceptable to authorities having jurisdiction.

1. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components shall be at least four times the maximum seismic forces to which they will be subjected.

C. Channel Support System: Shop- or field-fabricated support assembly made of slotted steel channels rated in tension, compression, and torsion forces and with accessories for attachment to braced component at one end and to building structure at the other end. Include matching components and corrosion-resistant coating.

D. Restraint Cables: ASTM A 603, galvanized-steel cables with end connections made of cadmium-plated steel assemblies with brackets, swivel, and bolts designed for restraining cable service; and with an automatic-locking and clamping device or double-cable clips.

E. Hanger Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections to hanger rod.

F. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

PART 3 - EXECUTION

3.01 DUCT INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and Coordination Drawings.

B. Install ducts according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.

C. Install round ducts in maximum practical lengths.

D. Install ducts with fewest possible joints.

E. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.

F. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.

G. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.

H. Install ducts with a clearance of 1 inch (25 mm), plus allowance for insulation thickness.

I. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.

J. Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal flanges of same metal thickness as the duct. Overlap openings on four sides by at least 1-1/2 inches (38 mm).

K. Where ducts pass through fire-rated interior partitions and exterior walls, install fire dampers. Comply with requirements in Division 23 Section "Air Duct Accessories" for fire and smoke dampers.

3.02 DUCT SEALING

A. Seal ducts for duct static-pressure, seal classes, and leakage classes specified in "Duct Schedule" Article according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

B. Seal ducts to the following seal classes according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible":

1. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
2. Outdoor, Supply-Air Ducts: Seal Class A.
3. Outdoor, Exhaust Ducts: Seal Class C.
4. Outdoor, Return-Air Ducts: Seal Class C.
5. Unconditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg (500 Pa) and Lower: Seal Class B.
6. Unconditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 2-Inch wg (500 Pa): Seal Class A.
7. Unconditioned Space, Exhaust Ducts: Seal Class C.
8. Unconditioned Space, Return-Air Ducts: Seal Class B.
9. Conditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg (500 Pa) and Lower: Seal Class C.
10. Conditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 2-Inch wg (500 Pa): Seal Class B.
11. Conditioned Space, Exhaust Ducts: Seal Class B.
12. Conditioned Space, Return-Air Ducts: Seal Class C.

3.03 HANGER AND SUPPORT INSTALLATION

A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 4, "Hangers and Supports."

B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.

1. Where practical, install concrete inserts before placing concrete.
2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches (100 mm) thick.
4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches (100 mm) thick.
5. Do not use powder-actuated concrete fasteners for seismic restraints.

C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 4-1 (Table 4-1M), "Rectangular Duct Hangers Minimum Size," and Table 4-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches (610 mm) of each elbow and within 48 inches (1200 mm) of each branch intersection.

D. Hangers Exposed to View: Threaded rod and angle or channel supports.

E. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum intervals of 16 feet (5 m).

F. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

3.04 SEISMIC-RESTRAINT-DEVICE INSTALLATION

A. Install ducts with hangers and braces designed to support the duct and to restrain against seismic forces required by applicable building codes. Comply with SMACNA's "Seismic Restraint Manual: Guidelines for Mechanical Systems."

1. Space lateral supports a maximum of 40 feet (12 m) o.c., and longitudinal supports a maximum of 80 feet (24 m) o.c.
2. Brace a change of direction longer than 12 feet (3.7 m).

B. Select seismic-restraint devices with capacities adequate to carry present and future static and seismic loads.

C. Install cables so they do not bend across edges of adjacent equipment or building structure.

D. Install cable restraints on ducts that are suspended with vibration isolators.

E. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction.

F. Attachment to Structure: If specific attachment is not indicated, anchor bracing and restraints to structure, to flanges of beams, to upper truss chords of bar joists, or to concrete members.

G. Drilling for and Setting Anchors:

1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcement or embedded items during drilling. Notify the Architect if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
4. Set anchors to manufacturer's recommended torque, using a torque wrench.
5. Install zinc-coated steel anchors for interior applications and stainless-steel anchors for applications exposed to weather.

3.05 CONNECTIONS

A. Make connections to equipment with flexible connectors complying with Division 23 Section "Air Duct Accessories."

B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

3.06 DUCT CLEANING

A. Clean new duct system(s) before testing, adjusting, and balancing.

B. Use service openings for entry and inspection.

1. Create new openings and install access panels appropriate for duct static-pressure class if required for cleaning access. Provide insulated panels for insulated or lined duct. Patch insulation and liner as recommended by duct liner manufacturer. Comply with Division 23 Section "Air Duct Accessories" for access panels and doors.
2. Disconnect and reconnect flexible ducts as needed for cleaning and inspection.
3. Remove and reinstall ceiling to gain access during the cleaning process.

C. Particulate Collection and Odor Control:

1. When venting vacuuming system inside the building, use HEPA filtration with 99.97 percent collection efficiency for 0.3-micron-size (or larger) particles.
2. When venting vacuuming system to outdoors, use filter to collect debris removed from HVAC system, and locate exhaust downwind and away from air intakes and other points of entry into building.

D. Clean the following components by removing surface contaminants and deposits:

1. Air outlets and inlets (registers, grilles, and diffusers).
2. Supply, return, and exhaust fans including fan housings, plenums (except ceiling supply and return plenums), scrolls, blades or vanes, shafts, baffles, dampers, and drive assemblies.
3. Air-handling unit internal surfaces and components including mixing box, coil section, air wash systems, spray eliminators, condensate drain pans, humidifiers and dehumidifiers, filters and filter sections, and condensate collectors and drains.
4. Coils and related components.
5. Return-air ducts, dampers, actuators, and turning vanes except in ceiling plenums and mechanical equipment rooms.
6. Supply-air ducts, dampers, actuators, and turning vanes.
7. Dedicated exhaust and ventilation components and makeup air systems.

E. Mechanical Cleaning Methodology:

1. Clean metal duct systems using mechanical cleaning methods that extract contaminants from within duct systems and remove contaminants from building.
2. Use vacuum-collection devices that are operated continuously during cleaning. Connect vacuum device to downstream end of duct sections so areas being cleaned are under negative pressure.
3. Use mechanical agitation to dislodge debris adhered to interior duct surfaces without damaging integrity of metal ducts, duct liner, or duct accessories.
4. Clean fibrous-glass duct liner with HEPA vacuuming equipment; do not permit duct liner to get wet. Replace fibrous-glass duct liner that is damaged, deteriorated, or delaminated or that has friable material, mold, or fungus growth.
5. Clean coils and coil drain pans according to NADCA 1992. Keep drain pan operational. Rinse coils with clean water to remove latent residues and cleaning materials; comb and straighten fins.
6. Provide drainage and cleanup for wash-down procedures.
7. Antimicrobial Agents and Coatings: Apply EPA-registered antimicrobial agents if fungus is present. Apply antimicrobial agents according to manufacturer's written instructions after removal of surface deposits and debris.

3.07 START UP

A. Air Balance: Comply with requirements in Division 23 Section "Testing, Adjusting, and Balancing for HVAC."

3.08 DUCT SCHEDULE

A. Fabricate ducts with galvanized sheet steel except as otherwise indicated and as follows:

1. Underground Ducts: Fiber-Glass Re-enforced Plastic as manufactured by Spunstrand.

B. Supply Ducts:

1. Ducts Connected to Fan Coil Units, Furnaces, Heat Pumps, and Terminal Units
   a. Pressure Class: Positive 1-inch wg (250 Pa)
   b. Minimum SMACNA Seal Class: A.
   c. SMACNA Leakage Class for Rectangular: 12.
   d. SMACNA Leakage Class for Round and Flat Oval: 12
2. Ducts Connected to Variable-Air-Volume Air-Handling Units :
   a. Pressure Class: Positive 3-inch wg (750 Pa).
   b. Minimum SMACNA Seal Class: A.
   c. SMACNA Leakage Class for Rectangular: 3.
   d. SMACNA Leakage Class for Round and Flat Oval: 3.

C. Return Ducts:

1. Ducts Connected to Fan Coil Units, Furnaces, Heat Pumps, and Terminal Units
   a. Pressure Class: Positive or negative 1-inch wg (250 Pa).

b. Minimum SMACNA Seal Class: A.

c. SMACNA Leakage Class for Rectangular: 12.

d. SMACNA Leakage Class for Round and Flat Oval: 12.

D. Exhaust Ducts:

1. Ducts Connected to Fans Exhausting (ASHRAE 62.1, Class 1 and 2) Air:

a. Pressure Class: Negative 1-inch wg (250 Pa).

b. Minimum SMACNA Seal Class: A if negative pressure, and A if positive pressure.

c. SMACNA Leakage Class for Rectangular: 12.

END OF SECTION 23 3113

SECTION 23 3300
AIR DUCT ACCESSORIES

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Backdraft and pressure relief dampers.
2. Manual volume dampers.
3. Control dampers.
4. Fire dampers
5. Smoke dampers
6. Combination fire and smoke dampers
7. Flange connectors.
8. Turning vanes.
9. Remote damper operators
10. Duct-mounted access doors.
11. Flexible connectors.
12. Flexible ducts.
13. Duct accessory hardware.

1.02 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: For duct accessories. Include plans, elevations, sections, details and attachments to other work.

1. Detail duct accessories fabrication and installation in ducts and other construction. Include dimensions, weights, loads, and required clearances; and method of field assembly into duct systems and other construction. Include the following:
    a. Special fittings.
    b. Manual volume damper installations.
    c. Control damper installations.
    d. Fire-damper and smoke-damper installations, including sleeves; and duct-mounted access doors.
    e. Wiring Diagrams: For power, signal, and control wiring.

C. Operation and maintenance data.

1.03 QUALITY ASSURANCE

A. Comply with 2012 NFPA 5000, 2013 NFPA 72, NFPA 90A, [25 IAM S&H Handbook, Topic 26.5], "Installation of Air Conditioning and Ventilating Systems," and with NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."

B. Comply with AMCA 500-D testing for damper rating.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.

1. Galvanized Coating Designation: G60 (Z180)
2. Exposed-Surface Finish: Mill phosphatized.

C. Stainless-Steel Sheets: Comply with ASTM A 480/A 480M, Type 304, and having a No. 2 finish for concealed ducts and finish for exposed ducts.

D. Aluminum Sheets: Comply with ASTM B 209 (ASTM B 209M), Alloy 3003, Temper H14; with mill finish for concealed ducts and standard, 1-side bright finish for exposed ducts.

E. Extruded Aluminum: Comply with ASTM B 221 (ASTM B 221M), Alloy 6063, Temper T6.

F. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.

G. Tie Rods: Galvanized steel, 1/4-inch (6-mm) minimum diameter for lengths 36 inches (900 mm) or less; 3/8-inch (10-mm) minimum diameter for lengths longer than 36 inches (900 mm).

2.02 BACKDRAFT AND PRESSURE RELIEF DAMPERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Air Balance Inc.; a division of Mestek, Inc.
2. American Warming and Ventilating; a division of Mestek, Inc.
3. Cesco Products; a division of Mestek, Inc.
4. Duro Dyne Inc.
5. Greenheck Fan Corporation.
6. Lloyd Industries, Inc.
7. Nailor Industries Inc.
8. NCA Manufacturing, Inc.
9. Pottorff; a division of PCI Industries, Inc.
10. Ruskin Company.
11. SEMCO Incorporated.
12. Vent Products Company, Inc.

B. Description: Gravity balanced.

C. Maximum Air Velocity: 2000 fpm (10 m/s).

D. Maximum System Pressure: 1-inch wg (0.25 kPa).

E. Frame: 0.052-inch- (1.3-mm-) thick, galvanized sheet steel with welded corners and mounting flange].

F. Blades: Multiple single-piece blades, center-pivoted, maximum 6-inch (150-mm) width, 0.025-inch- (0.6-mm-) thick, roll-formed aluminum with sealed edges.

G. Blade Action: Parallel.

H. Blade Seals: Neoprene, mechanically locked.

I. Blade Axles:

1. Material: Galvanized steel.
2. Diameter: 0.20 inch (5 mm).

J. Tie Bars and Brackets: Aluminum.

K. Return Spring: Adjustable tension.

L. Bearings: Steel ball

M. Accessories:

1. Adjustment device to permit setting for varying differential static pressure.
2. Counterweights and spring-assist kits for vertical airflow installations.
3. Electric actuators.
4. Chain pulls.
5. Screen Mounting: Front mounted in sleeve.
    a. Sleeve Thickness: 20-gage (1.0-mm) minimum.
    b. Sleeve Length: 6 inches (152 mm) minimum.
6. Screen Mounting: Rear mounted.
7. Screen Material: Galvanized steel
8. Screen Type: Bird
9. 90-degree stops.

2.03 MANUAL VOLUME DAMPERS

A. Standard, Steel, Locking Quadrant Manual Volume Dampers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    a. Air Balance Inc.; a division of Mestek, Inc.
    b. American Warming and Ventilating; a division of Mestek, Inc.
    c. Flexmaster U.S.A., Inc.
    d. McGill AirFlow LLC.
    e. METALAIRE, Inc.
    f. Nailor Industries Inc.
    g. Pottorff; a division of PCI Industries, Inc.
    h. Ruskin Company.
    i. Trox USA Inc.
    j. Vent Products Company, Inc.
2. Dampers must be Locking Quadrant Type. Non locking and simple wing nut type will NOT be acceptable.
3. Standard leakage rating, with linkage outside airstream.
4. Suitable for horizontal or vertical applications.
5. Frames:
    a. Hat-shaped, galvanized steel channels, 0.064-inch (1.62-mm) minimum thickness.
    b. Mitered and welded corners.
    c. Flanges for attaching to walls and flangeless frames for installing in ducts.
6. Blades:
    a. Multiple or single blade.
    b. Parallel- or opposed-blade design.
    c. Stiffen damper blades for stability.
    d. Galvanized-steel, 0.064 inch (1.62 mm) thick.
7. Blade Axles: Galvanized steel.
8. Bearings:
    a. Oil-impregnated bronze.

b. Dampers in ducts with pressure classes of 3-inch wg (750 Pa) or less shall have axles full length of damper blades and bearings at both ends of operating shaft.

9. Tie Bars and Brackets: Galvanized steel.

2.04 CONTROL DAMPERS

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

1. Duro Dyne Inc.
2. Flexmaster U.S.A., Inc.
3. Greenheck Fan Corporation.
4. METALAIRE, Inc.
5. Nailor Industries Inc.
6. Ruskin Company.
7. Vent Products Company, Inc.

B. Low-leakage rating and bearing AMCA's Certified Ratings Seal for both air performance and air leakage.

C. Control Dampers associated with the smoke removal system shall comply with UL-555S.

D. Frames:

1. Angle shaped.
2. Galvanized-steel channels, 0.064 inch (1.62 mm) thick.
3. Mitered and welded corners.

E. Blades:

1. Multiple blade with maximum blade width of 4 inches (100 mm).
2. Parallel- and opposed-blade design.
3. Galvanized steel.
4. 0.064 inch (1.62 mm) thick.
5. Blade Edging: Closed-cell neoprene edging, or replaceable rubber seals.

F. Blade Axles: 1/2-inch- (13-mm-) diameter; nonferrous metal; blade-linkage hardware of zinc-plated steel and brass; ends sealed against blade bearings.

1. Operating Temperature Range: From minus 40 to plus 200 deg F (minus 40 to plus 93 deg C).

G. Bearings:

1. Oil-impregnated bronze.
2. Dampers in ducts with pressure classes of 3-inch wg (750 Pa) or less shall have axles full length of damper blades and bearings at both ends of operating shaft.
3. Thrust bearings at each end of every blade.

2.05 FIRE DAMPERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers:

1. Greenheck Fan Corporation.
2. Nailor Industries Inc.
3. Pottorff; a division of PCI Industries, Inc.
4. Ruskin Company.

B. Type: Static and dynamic; rated and labeled according to UL 555 by an NRTL.

C. Closing rating in ducts up to 4-inch wg (1-kPa) static pressure class and minimum 4000-fpm (20-m/s) velocity.

D. Fire Rating: See floor plan drawings and verify with architectural wall rating.

E. Frame: Curtain type with blades outside airstream fabricated with roll-formed, 0.034-inch- (0.85-mm-) thick galvanized steel; with mitered and interlocking corners.

F. Mounting Sleeve: Factory- or field-installed, galvanized sheet steel.

1. Minimum Thickness: 0.052 or 0.138 inch (1.3 or 3.5 mm) thick, as indicated, and of length to suit application.

2. Exception: Omit sleeve where damper-frame width permits direct attachment of perimeter mounting angles on each side of wall or floor; thickness of damper frame must comply with sleeve requirements.

G. Mounting Orientation: Vertical or horizontal as indicated.

H. Blades: Roll-formed, interlocking, 0.034-inch- (0.85-mm-) thick, galvanized sheet steel. In place of interlocking blades, use full-length, 0.034-inch- (0.85-mm-) thick, galvanized-steel blade connectors.

I. Horizontal Dampers: Include blade lock and stainless-steel closure spring.

J. Heat-Responsive Device: Replaceable, 165 deg F rated, fusible links.

K. Heat-Responsive Device: Replaceable, 250 deg F rated, fusible links installed in all fire dampers serving Smoke Removal Systems.

2.06 SMOKE DAMPERS

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

1. Air Balance Inc.; a division of Mestek, Inc.

2. Cesco Products; a division of Mestek, Inc.

3. Greenheck Fan Corporation.

4. Nailor Industries Inc.

5. Ruskin Company.

B. General Requirements: Label according to UL 555S by an NRTL.

C. Smoke Detector: Integral, factory wired for single-point connection.

D. Frame: Curtain type with blades outside airstream except when located behind grille where blades may be inside airstream; fabricated with roll-formed, 0.034-inch thick galvanized steel; with mitered and interlocking corners.

E. Blades: Roll-formed, horizontal, interlocking, 0.034-inch thick, galvanized sheet steel. In place of interlocking blades, use full-length, 0.034-inch thick, galvanized-steel blade connectors.

F. Leakage: Class I.

G. Rated pressure and velocity to exceed design airflow conditions.

H. Mounting Sleeve: Factory-installed, 0.052-inch thick, galvanized sheet steel; length to suit wall or floor application with factory-furnished silicone calking.

I. Damper Motors: Two-position action.

J. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Division 23 Section "Common Motor Requirements for HVAC Equipment."

1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.

2. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in Division 23 Section "Instrumentation and Control for HVAC.

3. Permanent-Split-Capacitor or Shaded-Pole Motors: With oil-immersed and sealed gear trains.

4. Spring-Return Motors: Equip with an integral spiral-spring mechanism where indicated. Enclose entire spring mechanism in a removable housing designed for service or adjustments. Size for running torque rating of 150 in. x lbf and breakaway torque rating of 150 in. x lbf.

5. Outdoor Motors and Motors in Outdoor-Air Intakes: Equip with O-ring gaskets designed to make motors weatherproof. Equip motors with internal heaters to permit normal operation at minus 40 deg F.

6. Nonspring-Return Motors: For dampers larger than 25 sq. ft., size motor for running torque rating of 150 in. x lbf and breakaway torque rating of 300 in. x lbf.

7. Electrical Connection: 115 V, single phase, 60 Hz.

K. Accessories:

1. Auxiliary switches for position indication.

2. Test and reset switches, damper mounted.

2.07 COMBINATION FIRE AND SMOKE DAMPERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers:

1. Greenheck Fan Corporation.

2. Nailor Industries Inc.

3. Pottorff; a division of PCI Industries, Inc.

4. Ruskin Company.

B. Type: Static and dynamic; rated and labeled according to UL 555 and UL 555S by an NRTL.

C. Closing rating in ducts up to 4-inch wg (1-kPa) static pressure class and minimum 4000-fpm (20-m/s) velocity.

D. Fire Rating: See floor plan drawings and verify with architectural wall rating.

E. Frame: Multiple-blade type fabricated with roll-formed, 0.034-inch- (0.85-mm-) thick galvanized steel; with mitered and interlocking corners.

F. Heat-Responsive Device: Electric resettable link and switch package, factory installed, rated.

G. Smoke Detector: Integral, factory wired for single-point connection.

H. Blades: Roll-formed, horizontal, interlocking, 0.034-inch- (0.85-mm-) thick, galvanized sheet steel. In place of interlocking blades, use full-length, 0.034-inch- (0.85-mm-) thick, galvanized-steel blade connectors.

I. Leakage: Class I.

J. Rated pressure and velocity to exceed design airflow conditions.

K. Mounting Sleeve: Factory-installed, 0.052-inch- (1.3-mm-) thick, galvanized sheet steel; length to suit wall or floor application.

L. Damper Motors: two-position action.

M. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Division 23 Section "Common Motor Requirements for HVAC Equipment."

1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
2. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in Division 26 Sections.
3. Permanent-Split-Capacitor or Shaded-Pole Motors: With oil-immersed and sealed gear trains.
4. Spring-Return Motors: Equip with an integral spiral-spring mechanism where indicated. Enclose entire spring mechanism in a removable housing designed for service or adjustments. Size for running torque rating of 150 in. x lbf (17 N x m) and breakaway torque rating of 150 in. x lbf (17 N x m).
5. Outdoor Motors and Motors in Outdoor-Air Intakes: Equip with O-ring gaskets designed to make motors weatherproof. Equip motors with internal heaters to permit normal operation at minus 40 deg F (minus 40 deg C).
6. Nonspring-Return Motors: For dampers larger than 25 sq. ft. (2.3 sq. m), size motor for running torque rating of 150 in. x lbf (17 N x m) and breakaway torque rating of 300 in. x lbf (34 N x m).
7. Electrical Connection: 115 V, single phase, 60 Hz.

N. Accessories:

1. Test and reset switches, damper, mounted.

2.08 FLANGE CONNECTORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following[available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Ductmate Industries, Inc.
2. Nexus PDQ; Division of Shilco Holdings Inc.
3. Ward Industries, Inc.; a division of Hart & Cooley, Inc.

B. Description: Add-on factory-fabricated, slide-on transverse flange connectors, gaskets, and components.

C. Material: Galvanized steel.

D. Gage and Shape: Match connecting ductwork.

2.09 TURNING VANES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Ductmate Industries, Inc.
2. Duro Dyne Inc.
3. METALAIRE, Inc.
4. SEMCO Incorporated.
5. Ward Industries, Inc.; a division of Hart & Cooley, Inc.

B. Manufactured Turning Vanes for Metal Ducts: Curved blades of galvanized sheet steel; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.

1. Acoustic Turning Vanes: Fabricate airfoil-shaped aluminum extrusions with perforated faces and fibrous-glass fill.

C. Manufactured Turning Vanes for Nonmetal Ducts: Fabricate curved blades of resin-bonded fiberglass with acrylic polymer coating; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.

D. General Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 2-3, "Vanes and Vane Runners," and 2-4, "Vane Support in Elbows."

E. Vane Construction: Single wall.

F. Vane Construction: Single wall for ducts up to 48 inches (1200 mm) wide and double wall for larger dimensions.

2.010 DUCT-MOUNTED ACCESS DOORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:

1. Cesco Products; a division of Mestek, Inc.
2. Ductmate Industries, Inc.
3. Flexmaster U.S.A., Inc.
4. Greenheck Fan Corporation.
5. McGill AirFlow LLC.
6. Nailor Industries Inc.
7. Pottorff; a division of PCI Industries, Inc.
8. Ventfabrics, Inc.

Access doors to fire and smoke dampers to be Labeled “Fire Damper”, “Fire/Smoke Damper”, “Smoke Damper”, as applicable. (NFPA 5000, 8.8.8.4 and 8.10.5.4(6)).

B. Duct-Mounted Access Doors: Fabricate access panels according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 2-10, "Duct Access Doors and Panels," and 2-11, "Access Panels - Round Duct."

1. Door:
   a. Double wall, rectangular.
   b. Galvanized sheet metal with insulation fill and thickness as indicated for duct pressure class.
   c. Vision panel.
   d. Hinges and Latches: 1-by-1-inch (25-by-25-mm) butt or piano hinge and cam latches.
   e. Fabricate doors airtight and suitable for duct pressure class.
2. Frame: Galvanized sheet steel, with bend-over tabs and foam gaskets.
3. Number of Hinges and Locks:
   a. Access Doors Less Than 12 Inches (300 mm) Square: No hinges and two sash locks.
   b. Access Doors up to 18 Inches (460 mm) Square: Two hinges and two sash locks.
   c. Access Doors up to 24 by 48 Inches (600 by 1200 mm): Three hinges and two compression latches.
   d. Access Doors Larger Than 24 by 48 Inches (600 by 1200 mm): Four hinges and two compression latches with outside and inside handles.

C. Pressure Relief Access Door:

1. Door and Frame Material: Galvanized sheet steel.
2. Door: Single wall with metal thickness applicable for duct pressure class.
3. Operation: Open outward for positive-pressure ducts and inward for negative-pressure ducts.

4. Factory set at 10-inch wg (2500 Pa).
5. Doors close when pressures are within set-point range.
6. Hinge: Continuous piano.
7. Latches: Cam.
8. Seal: Neoprene or foam rubber.
9. Insulation Fill: 1-inch- (25-mm-) thick, fibrous-glass or polystyrene-foam board.

2.011 FLEXIBLE CONNECTORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:
   1. Ductmate Industries, Inc.
   2. Duro Dyne Inc.
   3. Ventfabrics, Inc.

B. Materials: Flame-retardant or noncombustible fabrics.

C. Coatings and Adhesives: Comply with UL 181, Class 1.

D. Metal-Edged Connectors: Factory fabricated with a fabric strip 3-1/2 inches (89 mm) wide attached to 2 strips of 2-3/4-inch- (70-mm-) wide, 0.028-inch- (0.7-mm-) thick, galvanized sheet steel or 0.032-inch- (0.8-mm-) thick aluminum sheets. Provide metal compatible with connected ducts.

E. Indoor System, Flexible Connector Fabric: Glass fabric double coated with neoprene.
   1. Minimum Weight: 26 oz./sq. yd. (880 g/sq. m).
   2. Tensile Strength: 480 lbf/inch (84 N/mm) in the warp and 360 lbf/inch (63 N/mm) in the filling.
   3. Service Temperature: Minus 40 to plus 200 deg F (Minus 40 to plus 93 deg C).

F. Outdoor System, Flexible Connector Fabric: Glass fabric double coated with weatherproof, synthetic rubber resistant to UV rays and ozone.
   1. Minimum Weight: 24 oz./sq. yd. (810 g/sq. m).
   2. Minimum Tensile Strength: 500 lbf/inch (88 N/mm) in the warp and 440 lbf/inch (77 N/mm) in the filling.
   3. Service Temperature: Minus 50 to plus 250 deg F (Minus 45 to plus 121 deg C).

G. Thrust Limits: Combination coil spring and elastomeric insert with spring and insert in compression, and with a load stop. Include rod and angle-iron brackets for attaching to fan discharge and duct.
   1. Frame: Steel, fabricated for connection to threaded rods and to allow for a maximum of 30 degrees of angular rod misalignment without binding or reducing isolation efficiency.
   2. Outdoor Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
   3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
   4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
   5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
   6. Elastomeric Element: Molded, oil-resistant rubber or neoprene.
   7. Coil Spring: Factory set and field adjustable for a maximum of 1/4-inch (6-mm) movement at start and stop.

2.012 FLEXIBLE DUCTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:

1. Flexmaster U.S.A., Inc.
2. McGill AirFlow LLC.
3. Ward Industries, Inc.; a division of Hart & Cooley, Inc.

B. Insulated, Flexible Duct: UL 181, Class 1, 2-ply vinyl film supported by helically wound, spring-steel wire; fibrous-glass insulation; polyethylene vapor-barrier film.

1. Pressure Rating: 10-inch wg (2500 Pa) positive and 1.0-inch wg (250 Pa) negative.
2. Maximum Air Velocity: 4000 fpm (20 m/s).
3. Temperature Range: Minus 10 to plus 160 deg F (Minus 23 to plus 71 deg C).
4. Insulation R-value: Comply with ASHRAE/IESNA 90.1-2004, R=4.

C. Insulated, Flexible Duct: UL 181, Class 1, black polymer film supported by helically wound, spring-steel wire; fibrous-glass insulation; polyethylene vapor-barrier film.

1. Pressure Rating: 4-inch wg (1000 Pa) positive and 0.5-inch wg (125 Pa) negative.
2. Maximum Air Velocity: 4000 fpm (20 m/s).
3. Temperature Range: Minus 20 to plus 175 deg F (Minus 29 to plus 79 deg C).
4. Insulation R-Value: Comply with ASHRAE/IESNA 90.1-2004, R=4.

D. Flexible Duct Connectors:

1. Clamps: Stainless-steel band with cadmium-plated hex screw to tighten band with a worm-gear action in sizes 3 through 18 inches (75 through 460 mm), to suit duct size.
2. Non-Clamp Connectors: Liquid adhesive plus tape.

2.013 DUCT ACCESSORY HARDWARE

A. Instrument Test Holes: Cast iron or cast aluminum to suit duct material, including screw cap and gasket. Size to allow insertion of pitot tube and other testing instruments and of length to suit duct-insulation thickness.

B. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts and in NAIMA AH116, "Fibrous Glass Duct Construction Standards," for fibrous-glass ducts.

B. Install duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel and fibrous-glass ducts, stainless-steel accessories in stainless-steel ducts, and aluminum accessories in aluminum ducts.

C. Install backdraft dampers at inlet of exhaust fans or exhaust ducts as close as possible to exhaust fan unless otherwise indicated.

D. Install volume dampers at points on supply, return, and exhaust systems where branches extend from larger ducts. Where dampers are installed in ducts having duct liner, install dampers with hat channels of same depth as liner, and terminate liner with nosing at hat channel.

1. Install steel volume dampers in steel ducts.
2. Install aluminum volume dampers in aluminum ducts.

E. Set dampers to fully open position before testing, adjusting, and balancing.

F. Install test holes at fan inlets and outlets and elsewhere as indicated.

G. Install fire and Fire/Smoke dampers according to UL listing.

H. Install duct access doors on sides of ducts to allow for inspecting, adjusting, and maintaining accessories and equipment at the following locations:

1. On both sides of duct coils.
2. Upstream and downstream from duct filters.
3. At outdoor-air intakes and mixed-air plenums.
4. At drain pans and seals.
5. Downstream from manual volume dampers, control dampers, backdraft dampers, and equipment.
6. Adjacent to and close enough to fire or smoke dampers, to reset or reinstall fusible links. Access doors for access to fire or smoke dampers having fusible links shall be pressure relief access doors; and shall be outward operation for access doors installed upstream from dampers and inward operation for access doors installed downstream from dampers.
7. At each change in direction and at maximum 50-foot (15-m) spacing.
8. Control devices requiring inspection.
9. Elsewhere as indicated.

I. Install access doors with swing against duct static pressure.

J. Access Door Sizes:

1. One-Hand or Inspection Access: 8 by 5 inches (200 by 125 mm).
2. Two-Hand Access: 12 by 6 inches (300 by 150 mm).
3. Head and Hand Access: 18 by 10 inches (460 by 250 mm).
4. Head and Shoulders Access: 21 by 14 inches (530 by 355 mm).
5. Body Access: 25 by 14 inches (635 by 355 mm).
6. Body plus Ladder Access: 25 by 17 inches (635 by 430 mm).

K. Label access doors according to Division 23 Section "Identification for HVAC Piping and Equipment" to indicate the purpose of access door.

L. Install flexible connectors to connect ducts to equipment.

M. For fans developing static pressures of 5-inch wg (1250 Pa) and more, cover flexible connectors with loaded vinyl sheet held in place with metal straps.

N. Connect terminal units to supply ducts[directly or] with maximum [12-inch (300-mm)] <Insert value> lengths of flexible duct. Do not use flexible ducts to change directions.

O. Connect diffusers or light troffer boots to ducts[directly or] with maximum [60-inch (1500-mm)] <Insert value> lengths of flexible duct clamped or strapped in place.

P. Connect flexible ducts to metal ducts with [adhesive] [liquid adhesive plus tape] [draw bands] [adhesive plus sheet metal screws].

Q. Install duct test holes where required for testing and balancing purposes.

R. Install thrust limits at centerline of thrust, symmetrical on both sides of equipment. Attach thrust limits at centerline of thrust and adjust to a maximum of 1/4-inch (6-mm) movement during start and stop of fans.

3.02 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. Operate dampers to verify full range of movement.
2. Inspect locations of access doors and verify that purpose of access door can be performed.

3. Operate fire and smoke dampers to verify full range of movement and verify that proper heat-response device is installed.
4. Inspect turning vanes for proper and secure installation.

END OF SECTION 23 3300

SECTION 23-3423
HVAC POWER VENTILATORS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. This Section includes the following:

1. Centrifugal roof ventilators.

1.03 PERFORMANCE REQUIREMENTS

A. Project Altitude: Base fan-performance ratings on actual Project site elevations.

B. Operating Limits: Classify according to AMCA 99.

1.04 SUBMITTALS

A. Product Data: Include rated capacities, furnished specialties, and accessories for each type of product indicated and include the following:

1. Certified fan performance curves with system operating conditions indicated.
2. Certified fan sound-power ratings.
3. Motor ratings and electrical characteristics, plus motor and electrical accessories.
4. Material thickness and finishes, including color charts.
5. Dampers, including housings, linkages, and operators.
6. Roof curbs.
7. Fan speed controllers.

B. 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. Wiring Diagrams: Power, signal, and control wiring.
2. Design Calculations: Calculate requirements for selecting vibration isolators and seismic restraints and for designing vibration isolation bases.
3. Vibration Isolation Base Details: Detail fabrication, including anchorages and attachments to structure and to supported equipment. Include auxiliary motor slides and rails, and base weights.

C. Coordination Drawings: Reflected ceiling plans and other details, 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. Roof framing and support members relative to duct penetrations.
2. Ceiling suspension assembly members.
3. Size and location of initial access modules for acoustical tile.
4. Ceiling-mounted items including light fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.

D. Field quality-control test reports.

E. Operation and Maintenance Data: For power ventilators to include in emergency, operation, and maintenance manuals.

1.05 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. AMCA Compliance: Products shall comply with performance requirements and shall be licensed to use the AMCA-Certified Ratings Seal.

C. NEMA Compliance: Motors and electrical accessories shall comply with NEMA standards.

D. UL Standard: Power ventilators shall comply with UL 705.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver fans as factory-assembled unit, to the extent allowable by shipping limitations, with protective crating and covering.

B. Disassemble and reassemble units, as required for moving to final location, according to manufacturer's written instructions.

C. Lift and support units with manufacturer's designated lifting or supporting points.

1.07 COORDINATION

A. Coordinate size and location of structural-steel support members.

B. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

C. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 07 Section "Roof Accessories."

1.08 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. Belts: 1 set(s) for each belt-driven unit.

PART 2 - PRODUCTS

2.01 CENTRIFUGAL ROOF VENTILATORS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

C. Basis-of-Design Product: Subject to compliance with requirements, provide [the product indicated on Drawings] <Insert manufacturer's name; product name or designation> or a comparable product by one of the following:

1. Greenheck
2. Hartzell Fan, Inc.
3. JencoFan; Div. of Breidert Air Products.
4. Loren Cook Company.
5. Madison Manufacturing.
6. New York Blower Company (The).
7. Penn Ventilation.

D. Description: Direct and Belt-driven centrifugal fans consisting of housing, wheel, fan shaft, bearings, motor and disconnect switch, drive assembly, and accessories.

E. Housing: Fabricated of steel with side sheets fastened with a deep lock seam or welded to scroll sheets.

1. Housing Discharge Arrangement: Adjustable to eight standard positions.

F. Fan Wheels: Single-width, single inlet; welded to cast-iron or cast-steel hub and spun-steel inlet cone, with hub keyed to shaft.

1. Blade Type: Backward inclined.

G. Fan Shaft: Turned, ground, and polished steel; keyed to wheel hub.

H. Shaft Bearings: Prelubricated and sealed, self-aligning, pillow-block-type ball bearings with ABMA 9, L_{50} of 200,000 hours] .

I. Belt Drives: Factory mounted, with final alignment and belt adjustment made after installation.

1. Service Factor Based on Fan Motor Size: 1.5.

2. Motor Pulleys: Adjustable pitch for use with motors through 5 hp; fixed pitch for use with larger motors. Select pulley so pitch adjustment is at the middle of adjustment range at fan design conditions.

3. Belts: Oil resistant, nonsparking, and nonstatic; matched sets for multiple belt drives.

4. Belt Guards: Fabricate of steel for motors mounted on outside of fan cabinet.

J. Accessories:

1. Inlet and Outlet: Flanged.

2. Companion Flanges: Rolled flanges for duct connections of same material as housing.

3. Backdraft Dampers: Gravity actuated with counterweight and interlocking aluminum blades with felt edges in steel frame installed on fan discharge.

4. Access Door: Gasketed door in scroll with latch-type handles.

5. Scroll Dampers: Single-blade damper installed at fan scroll top with adjustable linkage.

6. Inlet Screens: Removable wire mesh.

7. Drain Connections: NPS 3/4 threaded coupling drain connection installed at lowest point of housing.

8. Weather Hoods: Weather resistant with stamped vents over motor and drive compartment.

9. Discharge Dampers: Assembly with parallel blades constructed of two plates formed around and to shaft, channel frame, sealed ball bearings, with blades linked outside of airstream to single control lever of same material as housing.

10. Speed Controller: Solid-state control to reduce speed from 100 to less than 50 percent.

K. Coatings: Color-match enamel.

2.02 SOURCE QUALITY CONTROL

A. Sound-Power Level Ratings: Comply with AMCA 301, "Methods for Calculating Fan Sound Ratings from Laboratory Test Data." Factory test fans according to AMCA 300, "Reverberant Room Method for Sound Testing of Fans." Label fans with the AMCA-Certified Ratings Seal.

B. Fan Performance Ratings: Establish flow rate, pressure, power, air density, speed of rotation, and efficiency by factory tests and ratings according to AMCA 210, "Laboratory Methods of Testing Fans for Rating."

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install power ventilators level and plumb.

B. Support units using elastomeric mounts having a static deflection of 1 inch. Vibration- and seismic-control devices are specified in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."

1. Secure vibration and seismic controls to concrete bases using anchor bolts cast in concrete base.

C. Install floor-mounting units on concrete bases. Concrete, reinforcement, and formwork requirements are specified in Division 03 Section "Cast-in-Place Concrete."

D. Install floor-mounting units on concrete bases designed to withstand, without damage to equipment, the seismic force required by code. Concrete, reinforcement, and formwork requirements are specified in Division 03 Section "Cast-in-Place Concrete."

E. Secure roof-mounting fans to roof curbs with cadmium-plated hardware. Refer to Division 07 Section "Roof Accessories" for installation of roof curbs.

F. Ceiling Units: Suspend units from structure; use steel wire or metal straps.

G. Support suspended units from structure using threaded steel rods and elastomeric hangers having a static deflection of 1 inch . Vibration-control devices are specified in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."

H. Install units with clearances for service and maintenance.

I. Label units according to requirements specified in Division 23 Section "Identification for HVAC Piping and Equipment."

3.02 CONNECTIONS

A. Duct installation and connection requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors. Flexible connectors are specified in Division 23 Section "Air Duct Accessories."

B. Install ducts adjacent to power ventilators to allow service and maintenance.

C. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

D. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.03 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare test reports:

1. Verify that shipping, blocking, and bracing are removed.
2. Verify that unit is secure on mountings and supporting devices and that connections to ducts and electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.
3. Verify that cleaning and adjusting are complete.
4. Disconnect fan drive from motor, verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearing operation. Reconnect fan drive system, align and adjust belts, and install belt guards.
5. Adjust belt tension.
6. Adjust damper linkages for proper damper operation.
7. Verify lubrication for bearings and other moving parts.
8. Verify that manual and automatic volume control and fire and smoke dampers in connected ductwork systems are in fully open position.
9. Disable automatic temperature-control operators, energize motor and adjust fan to indicated rpm, and measure and record motor voltage and amperage.
10. Shut unit down and reconnect automatic temperature-control operators.
11. Remove and replace malfunctioning units and retest as specified above.

B. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3.04 ADJUSTING

A. Adjust damper linkages for proper damper operation.

B. Adjust belt tension.

C. Refer to Division 23 Section "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing procedures.

D. Replace fan and motor pulleys as required to achieve design airflow.

E. Lubricate bearings.

END OF SECTION 23 3423

SECTION 23 3713

DIFFUSERS, REGISTERS, AND GRILLES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes:

1. Rectangular and square ceiling diffusers.
2. Louver face diffusers.
3. Security registers and grilles.
4. Fixed face registers and grilles.

B. Related Sections:

1. Division 23 Section "Air Duct Accessories" for fire and smoke dampers and volume-control dampers not integral to diffusers, registers, and grilles.

1.03 SUBMITTALS

A. Product Data: For each type of 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. Samples for Initial Selection: For diffusers, registers, and grilles with factory-applied color finishes.

C. Samples for Verification: For diffusers, registers, and grilles, in manufacturer's standard sizes to verify color selected.

D. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from Installers of the items involved:

1. 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.

E. Source quality-control reports.

PART 2 - PRODUCTS

2.01 CEILING DIFFUSERS

A. Rectangular and Square Ceiling Diffusers <Insert drawing designation>:

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 on Drawingsor comparable product by one of the following:
   a. A-J Manufacturing Co., Inc.
   b. Anemostat Products; a Mestek company.

c. Carnes.
d. Hart & Cooley Inc.
e. Krueger.
f. METALAIRE, Inc.
g. Nailor Industries Inc.
h. Price Industries.
i. Titus.
j. Tuttle & Bailey.

3. Devices shall be specifically designed for variable-air-volume flows.
4. Material: Steel.
5. Finish: Baked enamel, color selected by Architect.
6. Face Size: 24 by 24 inches, 24 by 12 inches and 12 by 12 inches.
7. Face Style: Three cone.
8. Mounting: Surface or T-bar.
9. Pattern: Fixed.
10. Accessories:
    a. Equalizing grid.
    b. Plaster ring.
    c. Safety chain.
    d. Wire guard.
    e. Sectorizing baffles.
    f. Operating rod extension.

B. Louver Face Diffuser:
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 on Drawings] or comparable product by one of the following:
    a. A-J Manufacturing Co., Inc.
    b. Anemostat Products; a Mestek company.
    c. Carnes.
    d. METALAIRE, Inc.
    e. Nailor Industries Inc.
    f. Price Industries.
    g. Titus.
    h. Tuttle & Bailey.
3. Devices shall be specifically designed for variable-air-volume flows.
4. Material: Steel.
5. Finish: Baked enamel, color selected by Architect.
6. Mounting: Surface or T-bar.
7. Pattern: Four-way core style.
8. Accessories:
    a. Square to round neck adaptor.

b. Adjustable pattern vanes.
c. Throw reducing vanes.
d. Equalizing grid.
e. Plaster ring.
f. Safety chain.
g. Wire guard.
h. Sectorizing baffles.
i. Operating rod extension.

2.02 REGISTERS AND GRILLES

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 on Drawings or comparable product by one of the following:
   a. A-J Manufacturing Co., Inc.
   b. Anemostat Products; a Mestek company.
   c. Carnes.
   d. Dayus Register & Grille Inc.
   e. Hart & Cooley Inc.
   f. Krueger.
   g. METALAIRE, Inc.
   h. Nailor Industries Inc.
   i. Price Industries.
   j. Titus.
   k. Tuttle & Bailey.
3. Material: Steel.
4. Finish: Baked enamel, color selected by Architect.

B. Security Register:

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 on Drawings or comparable product by one of the following:
   a. A-J Manufacturing Co., Inc.
   b. Anemostat Products; a Mestek company.
   c. Carnes.
   d. Hart & Cooley Inc.
   e. Krueger.
   f. Nailor Industries Inc.
   g. Price Industries.
   h. Titus.
   i. Tuttle & Bailey.
3. Security Level: Maximum and suicide deterrent.
4. Application: Ducted supply, ducted return.
5. Material: Steel.

6. Material Thickness: 0.19 inch.
7. Finish: Baked enamel, color selected by Architect.
8. Face Arrangement:
    a. Shape: Rectangular.
    b. Design: Perforated.
    c. Frame: Ye].
    d. Deflection: Zero degrees.
    e. Core: None.
    f. 3/16-inch- thick, perforated faceplate with 5/16-inch- diameter holes spaced 7/16 inch o.c., staggered at 60 degrees.
9. Damper Operation: None.
10. Wall Sleeve: 1/8 inch (3 mm) welded to face, Mechanically fastened to border.
11. Mounting1-1/4-by-1-1/4-by-3/16-inch cast-in-place frame and tamperproof machine screws.

C. Security Grille :
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 on Drawings or comparable product by one of the following:
    a. A-J Manufacturing Co., Inc.
    b. Anemostat Products; a Mestek company.
    c. Carnes.
    d. Hart & Cooley Inc.
    e. Krueger.
    f. Nailor Industries Inc.
    g. Price Industries.
    h. Titus.
    i. Tuttle & Bailey.
3. Security Level: Maximum and suicide deterrent.
4. Application: Ducted return.
5. Material: Steel.
6. Material Thickness: 0.19 inch .
7. Finish: Baked enamel, color selected by Architect.
8. Face Arrangement:
    a. Shape: Rectangular.
    b. Design: Perforated.
    c. Frame: Yes.
    d. Deflection: Zero degrees.
    e. Core: None.
    f. 3/16-inch- thick perforated faceplate with 5/16-inch- diameter holes spaced 7/16 inch o.c., staggered at 60 degrees.
9. Wall Sleeve: 1/8 inch welded to face, Mechanically fastened to border.

10. Mounting: 1-1/4-by-1-1/4-by-3/16-inch cast-in-place frame and tamperproof machine screws.
11. Air Flows:
    a. 6x6: 10-35 cfm
    b. 8x8: 40-85 cfm
    c. 10x10: 86-105 cfm
    d. 12x12: 106-150 cfm
    e. 14x14: 151-205 cfm
    f. 16x16: 206-207 cfm
    g. 18x18: 271-340 cfm
    h. 20x20: 341-420 cfm
    i. 22x22: 421-505 cfm
    j. 24x24: 506-600 cfm
    k. 26x26: 601-705 cfm
    l. 28x28: 706-820 cfm
    m. 30x30: 821-940 cfm

D. Fixed Face Register:
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 on Drawings or comparable product by one of the following:
    a. A-J Manufacturing Co., Inc.
    b. Anemostat Products; a Mestek company.
    c. Carnes.
    d. Dayus Register & Grille Inc.
    e. Hart & Cooley Inc.
    f. Krueger.
    g. Nailor Industries Inc.
    h. Price Industries.
    i. Titus.
    j. Tuttle & Bailey.
3. Material: Steel.
4. Finish: Baked enamel, color selected by Architect.
5. Face Arrangement: 1/2-by-1/2-by-1/2-inch grid core.
6. Core Construction: Integral.
7. Frame: 1-1/4 inches wide.
8. Mounting: Countersunk screw.

E. Fixed Face Grille:
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 on Drawings or comparable product by one of the following:

a. A-J Manufacturing Co., Inc.
b. Anemostat Products; a Mestek company.
c. Carnes.
d. Dayus Register & Grille Inc.
e. Hart & Cooley Inc.
f. Krueger.
g. Nailor Industries Inc.
h. Price Industries.
i. Titus.
j. Tuttle & Bailey.

3. Material: Steel.
4. Finish: Baked enamel, color selected by Architect] <Insert finish>.
5. Face Arrangement: 1/2-by-1/2-by-1/2-inch grid core.
6. Core Construction: Integral.
7. Frame: 1-1/4 inches wide.
8. Mounting: Countersunk screw.
9. Accessory: Filter.

2.03 SOURCE QUALITY CONTROL

A. Verification of Performance: Rate diffusers, registers, and grilles according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine areas where diffusers, registers, and grilles are to be installed for compliance with requirements for installation tolerances and other conditions affecting performance of equipment.

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

3.02 INSTALLATION

A. Install diffusers, registers, and grilles level and plumb.

B. Ceiling-Mounted Outlets and Inlets: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practical. For units installed in lay-in ceiling panels, locate units in the center of panel. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.

C. Install diffusers, registers, and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

3.03 ADJUSTING

A. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.

END OF SECTION 23 3713

SECTION 23 6213

PACKAGED AIR COOLED DX AIR CONDITIONING UNITS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

B. Specifications throughout all Divisions of the Project Manual are directly applicable to this Section, and this Section is directly applicable to them.

1.02 SUMMARY

A. Perform all Work required to provide a fully packaged air-cooled, direct expansion (DX) air conditioning (AC) unit. The packaged AC unit shall perform to manufacturer's product data, installation instructions, Start-up instructions and maintenance information indicated by all Specification Sections, and Contract Documents with supplementary items necessary for proper operation.

B. Air-cooled AC unit shall consist of hermetic scroll compressor component utilizing R-401A evaporator coil, air-cooled condenser coil, condenser fans, supply fan, vibration isolation assemblies, and microprocessor control center.

1.03 REFERENCE STANDARDS

A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.

B. All reference amendments adopted prior to the effective date of this Contract shall be applicable to this Project.

C. All materials, installation and workmanship shall comply with the applicable requirements and standards addressed within the following references:

1. ARI - 1060 Rating Air-to-Air Energy Recovery Equipment.
2. ARI 210/240 - Unitary Air-Conditioning and Air-Source Heat Pump Equipment.
3. ARI 340/360 - Commercial Unitary Air-Conditioning and Air-Source Heat Pump Equipment.
4. ARI 410 - Standard for Forced-Circulation Air-Cooling and Air-Heating Coils.
5. ANSI/ASHRAE 15 - Safety Standard for Refrigeration Systems.
6. ASHRAE 90.1 - Energy Standard for Buildings Except Low High Rise Residential Buildings.
7. ASHRAE 52.2 - Method of Testing General Ventilation Air-Cleaning Devices Used for Removal Efficiency.
8. ANSI/AMCA Standard 210 - Laboratory Methods of Testing Fans for Aerodynamic Performance Rating.
9. AMCA Publication 211 - Certified Ratings Program - Product Rating Manual for Fan Air Performance.
10. AMCA Standard 300 - Reverberant Room Method for Sound Testing of Fans.
11. AMCA Publication 311 - Certified Ratings Program.
12. AMBA Method of Evaluating Load Ratings of Bearings ANSI-11.
13. ANSI/AMCA Standard 204 - Balance Quality and Vibration Levels for Fans.
14. ASTM B-117 - Standard Practice for Operating Salt Spray (Fog) Apparatus.
15. ANSI Z21.47 - Gas-Fired Central Furnaces.

16. ANSI/ASHRAE Standard 135 BacNet - A Data Communication Protocol for Building Automation and Control Network.
17. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems.

1.04 QUALITY ASSURANCE

A. The design of the unit shall be AGA and ARI certified as combination heating-cooling units for rooftop installation.

B. Unit construction shall comply with ASHRAE 15 safety code, NEC, and UL applicable codes.

C. Cooling capacity ratings shall be in accordance with ARI standard 210/240, most recent edition.

D. In no case shall the air cooled packaged DX air conditioning unit selected have an EER or SEER (if cooling capacity is less than 65,000 Btu/hr) less than that specified in Table 6.8.1A of AHRAE 90.1.

E. Insulation and adhesive shall meet NFPA 90A requirements.

1.05 SUBMITTALS

A. Product Data:

1. Provide literature that indicates dimensions, weight, loading, clearances, capacities, gauges, thickness, and finishes of materials, electrical characteristics and connections.
2. Rigging, installation, testing, Start-up and operating instructions, maintenance data including type and quantity of oil and refrigerant change (pounds), parts lists, and troubleshooting guide.
3. Data on energy input versus cooling load output from 100 percent to 20 percent of full load with constant entering condenser air temperature.
4. Information about control and wiring diagrams.
5. Product test data on sound power levels for both fan inlet and outlet at the rated design capacity.
6. Operating data such as fans speeds, compressor LRA and RA, sound levels
7. Product data on special condenser coating.
8. Product data on all condenser fan accessories such as controls.

1.06 DELIVERY, STORAGE AND HANDLING

A. Deliver, store, protect and handle products to the Project Site under provisions of Division 01 and Division 20.

B. Accept products on Site in factory-fabricated protective containers or coverings, with factory-installed shipping skids and lifting lugs. Inspect for damage.

C. Store in clean dry place and protect from weather and construction traffic. Handle carefully to avoid damage to components, enclosures, and finish.

D. Check and maintain equipment on monthly basis to ensure equipment is being stored in accordance with manufacturer's recommended practices. Storage record shall be maintained that indicates above requirements have been met.

1.07 EXTRA MATERIALS

A. Provide an additional replacement set of 2-inch thick pleated filters arranged for approximate filter face velocity of 300 feet per minute (fpm); maximum 350 fpm.

1.08 WARRANTY

A. Units shall be furnished with full coverage warranty against defects in materials. Warranty on the complete unit shall be for one year from the Substantial Completion date. On the compressors, warranty shall be for five (5) years from the Substantial Completion date.

PART 2 - PRODUCTS

2.01 GENERAL

A. All materials shall meet or exceed all applicable referenced standards, federal, state and local requirements, and conform to codes and ordinances of authorities having jurisdiction.

B. Factory assembled air-cooled packaged DX air conditioning unit using a refrigerant charge as noted on the drawings with the following construction:

1. Compressors and unit controls contained within single isolated compartment.
2. Scroll compressors installed on sheet metal deck with rubber isolation mounts for quiet efficient operation.
3. Compressor isolation valves.
4. DX coil(s).
5. Condenser coil(s) with protective coating on fins.
6. Stainless steel evaporator coil support.
7. Stainless steel drain pan.
8. Blower motor(s) installed on rubber isolation mounts for quiet efficient operation.
9. Direct drive condenser fan(s).
10. Bottom access return and supply air.
11. Air filters with multiple options, efficiencies and monitoring devices.
12. Roof sloped for proper drainage.
13. Single point power connection.
14. Thermostatic expansion valves on DX coils.
15. Manual reset high pressure cutoffs.
16. Automatic reset low pressure cutoffs.
17. Run test report, wiring diagram, installation manual and Start-up form in control access compartment.
18. Weather-resistant finish paint coating which passes 2,000 hour salt spray test.

C. Compressor shall have load capacity ratings per the requirements ARI 210/240.

D. Unit efficiency shall be in compliance with the requirements of the International Energy Conservation Code AHSRAE 90.

2.02 MANUFACTURERS

A. York, Inc.

B. Trane, Inc.

C. Carrier, Inc.

D. McQuay

E. Aaon

2.03 COMPRESSORS

A. Each scroll compressor shall be fitted with crankcase heater, vibration isolators, refrigerant dryer, external connections for external oil level control if multiple compressors are required, motor winding protection, high and low pressure cutouts, plus any other protective or operating device or fitting required and provided as standard by the compressor manufacturer. Compressors shall be designed for continuous or cycling operation at the specified design conditions without detrimental effect.

2.04 FANS, MOTORS, AND DRIVES

A. Indoor airflow and external static pressure capabilities shall be no less than the values indicated on the Drawings. Internal static pressure shall include a minimum allowance for 2-inch pleated type filters.

B. All fan(s) and motor(s) shall be in compliance with the fan power limitation in Table 6.5.3.1 of ASHRAE 90.1

C. Outdoor fans shall be direct drive, shaft mounted propeller type, statically and dynamically balanced. Outdoor fan motor(s) shall be TEFC weather resistant with permanently lubricated bearings.

D. Indoor fans shall be direct drive, shaft mounted centrifugal type, statically and dynamically balanced. Indoor fan motor(s) shall be TEFC with sealed lubricated bearings.

2.05 AIR FILTERS

A. Front frame loaded filters shall be easily accessible for removal through access panels or doors.

B. Filters shall be MERV 8 efficiency in accordance with ASHRAE Standard 52.2. Furnish additional filter casings and filters per the Drawings.

2.06 COILS AND CAPACITY CONTROL

A. Coils shall be standard construction copper tubes with aluminum fins. All copper work shall be brazed. Coils shall be factory pressure tested.

B. Indoor coils shall be capable of the performance indicated on the Drawings with no “blow-off” of condensate.

C. Indoor coils shall be equipped with a sloped, corrosion resistant condensate pan terminating at a condensate drain located outside the unit cabinet.

D. Units smaller than 7.5 tons nominal capacity shall not be required to have part-load refrigeration capability. Each unit of 7.5 to 18 tons refrigeration capacity shall have minimum two (2) stages of cooling.

E. The refrigeration system shall be equipped with filter dryers on the liquid lines and service valves with gauge port connections on the discharge and suction lines.

2.07 GAS HEAT EXCHANGER

A. Units shall be equipped with a natural gas burning heat exchanger of corrosion resistant components to provide efficient heating operation. Burner shall be designed for natural gas supply at seven (7) inches water column manifold pressure.

B. Burner shall be equipped with electronic or spark ignition, flame sensor, manual shut-off, and A.G.A. approved controls.

C. The induced draft blower shall pre-purge and shall be provided with a proving switch to prevent burner operation if blower is not in operation.

D. Units with a heating input rating in excess of 150,000 BTUH shall be equipped with gas valves with minimum two-stages of capacity.

E. A.G.A. thermal efficiency for the heat exchanger shall minimum 80 percent.

F. Limit switch shall shutdown the burner in case operating controls fail.

2.08 ELECTRICAL REQUIREMENTS

A. The unit shall be designed for the electrical service designated on the Drawings.

B. Arrange electrical cabinet for connecting electrical service at one point only.

C. Power and control wiring of the unit shall be factory installed complete within the unit. Provide correctly identified suitable lugs and terminal strips for field connection to electrical power and external controls.

D. Factory equip unit with motor starters for each of the motor driven components.

2.09 CONTROLS

A. Factory package controls from equipment manufacturer, with BACNet compatable interface.

2.10 ACCESSORIES

A. Roof Curb:

1. Furnish one complete roof curb for each packaged unit, designed for weatherproof installation. Curb shall be furnished approved by unit manufacturer.

2. Supply and return ducts shall connect through the curbed opening with flexible connections to the bottom of the A/C unit, unless shown otherwise on the Drawings.

3. Curb shall comply with National Roofing Contractors Association requirements.

4. Slope of roof curb shall match roof slope to provide for level support of packaged unit.

5. Contractor shall be responsible for coordination of curb, supply and return ducts, and weatherproofing of the entire installation.

B. On units of nominal cooling capacity 15 tons and higher, supply and install a 14-inch minimum height vibration isolation roof curb fabricated to the National Roofing Contractor's Association. The curb shall be fabricated of aluminum upper and lower sections incorporating vibration isolation springs with a minimum of 1-inch deflection. Provide a continuous weather resistant skirt or seal to cover the spring assembly.

C. Outside air intake assembly, including low-leak dampers, weather hood, and motorized open/closed actuators.

D. Where applicable per AHSRAE 90.1 (Climate Zones), units shall be equipped with economizers as specified on the Drawings. Economizers shall include a fully modulating 100 percent outside air damper that is mechanically interlocked with a return air damper.

1. Where designated on the Drawings, units shall be equipped with a powered exhaust fan and necessary controls to prevent pressurization of the building during economizer operation.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Installation shall meet or exceed all applicable federal, state and local requirements, referenced standards and conform to codes and ordinances of authorities having jurisdiction.

B. All installation shall be in accordance with manufacturer's published recommendations.

C. Gas/electric packaged air conditioning units shall be installed according to manufacturer's recommendations to be completely weatherproof. Protect the roof from damage during installation. Secure factory touch-up paint to repair scratches and minor damage to equipment prior to Start-up.

D. Power wiring to the units, including externally mounted service disconnect switch, shall be furnished and installed under Division 26. Installing Contractor shall be provided with the manufacturer's Shop Drawings as required for power wiring installation.

E. Controls for conditioned spaces shall be as required under Division 25, Building Automation System. Control wiring shall be under Division 23. Actual pulling of wires may be accomplished by subcontract or Division 26 Contractor; however, Division 25 shall retain responsibility for correctness of wiring, connections, and full operation of the control system.

3.02 TESTING

A. Equipment shall be cycled through all heating, cooling, and ventilation cycles to ensure proper operation of all components and controls prior to test and balance.

B. At time of Start-up, manufacturer's representative shall visit the Project Site and verify that unit installation and performance is satisfactory, and to make any adjustments or settings to unit operating and safety controls that may be required.

C. Include Start-up checkout service of at least one working day for one service technician, including a written report of operational check provided to the Owner. Owner's Representative may require that the Start-up service be performed with Owner's attendance and on-site review.

D. Clean filters shall be placed within the unit at the time of Substantial Completion.

END OF SECTION 23 6213

SECTION 23 8126

SPLIT-SYSTEM AIR-CONDITIONERS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. This Section includes split-system air-conditioning units consisting of separate evaporator-fan and compressor-condenser components. Units are designed for exposed or concealed mounting, and may be connected to ducts.

1.03 SUBMITTALS

A. Product Data: Include rated capacities, furnished specialties, and accessories for each type of product indicated. Include performance data in terms of capacities, outlet velocities, static pressures, sound power characteristics, motor requirements, and electrical characteristics.

B. Shop Drawings: Diagram power, signal, and control wiring.

C. Samples for Initial Selection: For units with factory-applied color finishes.

D. Field quality-control test reports.

E. Operation and Maintenance Data: For split-system air-conditioning units to include in emergency, operation, and maintenance manuals.

F. Warranty: Special warranty specified in this Section.

1.04 QUALITY ASSURANCE

A. Product Options: Drawings indicate size, profiles, and dimensional requirements of split-system units and are based on the specific system indicated. Refer to Division 01 Section "Product Requirements."

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1-2004, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."

D. ASHRAE/IESNA 90.1-2004 Compliance: Applicable requirements in ASHRAE/IESNA 90.1-2004, Section 6 - "Heating, Ventilating, and Air-Conditioning."

1.05 COORDINATION

A. Coordinate size and location of concrete bases for units. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork are specified in Division 03 Section "Cast-in-Place Concrete."

B. Coordinate size, location, and connection details with roof curbs, equipment supports, and roof penetrations specified in Division 07 Section "Roof Accessories."

1.06 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of split-system air-conditioning units that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

1.07 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. Filters: One set of filters for each unit.
2. Fan Belts: One set of belts for each unit.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Trane
2. Mitsubishi
3. Daikin, Inc.

2.02 WALL-MOUNTING, EVAPORATOR-FAN COMPONENTS

A. Cabinet: Enameled steel with removable panels on front and ends in color selected by Architect, and discharge drain pans with drain connection.

1. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1-2004.
2. Drain Pan and Drain Connection: Comply with ASHRAE 62.1-2004.

B. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins, complying with ARI 210/240, and with thermal-expansion valve.

C. Electric Coil: Helical, nickel-chrome, resistance-wire heating elements with refractory ceramic support bushings; automatic-reset thermal cutout; built-in magnetic contactors; manual-reset thermal cutout; airflow proving device; and one-time fuses in terminal box for overcurrent protection.

D. Fan: Direct drive, centrifugal fan.

E. Fan Motors: Comply with requirements in Division 23 Section "Common Motor Requirements for HVAC Equipment."

1. Special Motor Features: Multitapped, multispeed with internal thermal protection and permanent lubrication.

F. Filters: Permanent, cleanable.

2.03 AIR-COOLED, COMPRESSOR-CONDENSER COMPONENTS

A. Casing: Steel, finished with baked enamel in color selected by Architect, with removable panels for access to controls, weep holes for water drainage, and mounting holes in base. Provide brass service valves, fittings, and gage ports on exterior of casing.

B. Compressor: Hermetically sealed with crankcase heater and mounted on vibration isolation. Compressor motor shall have thermal- and current-sensitive overload devices, start capacitor, relay, and contactor.

1. Compressor Type: Scroll.
2. Two-speed compressor motor with manual-reset high-pressure switch and automatic-reset low-pressure switch.
3. Refrigerant: R-407C or R-410A.

C. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins, complying with ARI 210/240, and with liquid subcooler.

D. Heat Pump Components: Reversing valve and low-temperature air cut-off thermostat.

E. Fan: Aluminum-propeller type, directly connected to motor.

F. Motor: Permanently lubricated, with integral thermal-overload protection.

G. Low Ambient Kit: Permits operation down to 25 deg F (7 deg C).

H. Mounting Base: Polyethylene.

I. Minimum Energy Efficiency: Comply with ASHRAE/IESNA 90.1-2004, "Energy Standard for Buildings except Low-Rise Residential Buildings."

2.04 ACCESSORIES

A. Thermostat: Low voltage with subbase to control compressor and evaporator fan.

B. Thermostat: Wireless infrared functioning to remotely control compressor and evaporator fan, with the following features:

1. Compressor time delay.
2. 24-hour time control of system stop and start.
3. Liquid-crystal display indicating temperature, set-point temperature, time setting, operating mode, and fan speed.
4. Fan-speed selection, including auto setting.

C. Automatic-reset timer to prevent rapid cycling of compressor.

D. Factory Refrigerant Line Kits: Soft-annealed copper suction and liquid lines factory cleaned, dried, pressurized, and sealed; factory-insulated suction line with flared fittings at both ends.

1. Minimum Insulation Thickness: 1/2 inch (13 mm) thick.

E. Factory provided condensate pump.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install units level and plumb.

B. Install evaporator-fan components using manufacturer's standard mounting devices securely fastened to building structure.

C. Install roof-mounting compressor-condenser components on equipment supports. Units to supports with removable, cadmium-plated fasteners.

D. Install and connect precharged refrigerant tubing to component's quick-connect fittings. Install tubing to allow access to unit.

3.02 CONNECTIONS

A. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to unit to allow service and maintenance.

C. Duct Connections: Duct installation requirements are specified in Division 23 Section "Metal Ducts." Drawings indicate the general arrangement of ducts. Connect ducts to split-system air-conditioning units with flexible duct connectors. Flexible duct connectors are specified in Division 23 Section "Air Duct Accessories."

D. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

E. Electrical Connections: Comply with requirements in Division 26 Sections for power wiring, switches, and motor controls.

3.03 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect test, and adjust field-assembled components and equipment installation, including connections and to assist in field testing. Report results in writing.

B. Perform the following field tests and inspections and prepare test reports:

1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.

2. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.

3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

C. Remove and replace malfunctioning units and retest as specified above.

3.04 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.

3.05 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain units. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION 23 8126

SECTION 26 0500

COMMON WORK RESULTS FOR ELECTRICAL

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Grounding and bonding.

B. Connection of utilization equipment.

C. Supports.

D. Identification.

E. Electrical Basic Requirements specifically applicable to Division 26, in addition to the requirements of Division 00 7000 - General Conditions of the Contract.

1.02 SUBMITTALS

A. Submit shop drawings and product data grouped to include complete submittals of related systems, Products, and accessories in a single submittal. Engineer will commence review only when all data has been received.

B. Submittal form to identify Project, contractor, subcontractor or supplier; and pertinent Contract Document references. Mark dimensions and values in units to match those specified.

C. Apply Contractor's stamp, signed or initial, certifying that review, verification of Products required, field dimensions, adjacent construction Work and coordination of information is in accordance with the requirements of the Work and Contract Documents.

D. The Contractor shall determine and verify field measurements and field construction criteria for conformance with Drawings and Specifications and for conflicts with other items of Construction past or present. He shall coordinate each submittal with the requirements of the Work and of the Contract Documents and notify the Engineer in writing, at the time of the submission, of any and all deviations in the submittals from requirements of the Work and Contract Documents.

No fabrication or work which requires submittals shall begin until submittals are returned with the Engineer's approval.

E. Identify variations for Contract Documents and Product or system limitations which may be detrimental to successful performance of the completed Work.

F. Engineer's review does not constitute acceptance or responsibility for accuracy or dimensions, nor shall it relieve the Contractor from meeting any requirements of the Work and Contract Documents, nor shall it constitute approval for any deviation from the Contract Documents unless such deviations are specifically stated as such on the submittal and specifically allowed by the Engineer by specific written notification for each such variation. The Engineer's review will not relieve the Contractor from responsibility for errors or omissions in the Shop Drawings.

G. Revise and resubmit submittals as required; identify all changes made since previous submittal.

1.03 SUBSTITUTIONS

A. Prior approval of materials and equipment in Division 26 will not be considered. Contract documents indicate specified equipment and acceptable alternatives. Any other equipment/material proposed must meet or exceed that specified. Equipment/material will be reviewed for compliance during submittal review process per Section 1.2.

B. Engineer will consider requests for Substitutions only at Submittal Review.

C. Document each request with compete data substantiating compliance of proposed Substitution with Contract Documents.

1.04 REGULATORY REQUIREMENTS

A. All electrical work shall be performed in strict accordance with the UBC, ANSI, NEC, NFPA, IECC, all applicable provisions of the Local Authorities having jurisdiction and the State of Arizona. All materials and labor necessary to comply with rules, regulations, and ordinances shall be provided. Where the Drawings and/or specifications indicate material or construction in excess of code requirements or visa-versa, the more stringent application shall govern.

B. Furnish products listed by Underwriters Laboratories, Inc. or other testing firm acceptable to authority having jurisdiction.

C. Permits necessary for the performance of the work under this contract shall be secured and paid for by the Contractor. Final inspection by the Engineer will not be made or certificate of final payment issued until certificates of satisfactory inspection from the inspection authorities are delivered.

1.05 PROJECT CONDITIONS

A. Verify field measurements and circuiting arrangements are as shown on Drawings.

1.06 COORDINATION

A. Obtain and review shop drawings, product data, and manufacturer's instructions for equipment furnished under other Sections to determine connection locations and requirements.

B. Sequence rough-in of electrical connections to coordinate with installation and start-up of equipment furnished under other Sections.

1.07 RECORD AS-BUILT DRAWINGS

A. The Contractor shall modify original reproducible drawings and two sets of the Project Manual delineating recorded as-built conditions of the Project or record documents complied from the job records. The Contractor may obtain reproducible drawings from the office of the Architect or Engineer. This set of documents shall show all changes in the Work including actual location of all Work.

PART 2 PRODUCTS

2.01 GROUNDING MATERIALS

A. Ground Rod: Copper, 5/8 inch diameter x 10 feet length.

B. Active Electrodes: Not Applicable.

C. Mechanical Connectors: Bronze.

2.02 BASIC MATERIAL

A. Steel channel: Galvanized or painted steel.

B. Miscellaneous Hardware: Treat for corrosion resistance.

C. Nameplates: Engraved three-layer laminated plastic, black letters on white background.

D. Wire and Cable Markers: Cloth markers, split sleeve or tubing type.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install Products in accordance with manufacturer's instructions.

B. Install ground electrodes at locations indicated. Install additional rod electrodes as required to meet Regulatory Requirements.

C. Provide bonding to meet Regulatory Requirements.

D. Provide equipment grounding conductor for all branch circuits

E. Make electrical connections to utilization equipment in accordance with equipment manufacturer's instructions.

1. Verify that wiring and outlet rough-in work is complete and that utilization equipment is ready for electrical connection, wiring, and energization.
2. Make wiring connections in control panel or in wiring compartment of pre-wired equipment. Provide interconnecting wiring where indicated.
3. Install and connect disconnect switches, controllers, control stations, and control devices as indicated.
4. Make conduit connections to equipment using flexible conduit. Use liquidtight flexible conduit in damp or wet locations.
5. Install pre-fabricated cord set where connection with attachment plug is indicated or specified, or use attachment plug with suitable strain-relief clamps.

F. Install support systems sized and fastened to accommodate weight of equipment and conduit, including wiring, which they carry.
1. Fasten hanger rods, conduit clamps, and outlet and junction boxes to building structure using precast insert system, expansion anchors, preset inserts, beam clamps and spring steel clips.
2. Use toggle bolts or hollow wall fasteners in hollow masonry, plaster, or gypsum board partitions and walls; expansion anchors or preset inserts in solid masonry walls; self-drilling anchors or expansion anchor on concrete surfaces; sheet metal screws in sheet metal studs; and wood screws in wood construction.
3. Do not fasten supports to piping, ceiling support wires, ductwork, mechanical equipment, or conduit.
4. Do not use powder-actuated anchors.
5. Do not drill structural steel members.
6. Fabricate supports from structural steel or steel channel.
7. Install surface-mounted cabinets and loadcenters with minimum of four anchors.
8. Provide steel channel supports to stand cabinets 1 inch off wall in wet locations.
9. Bridge studs top and bottom with channels to support flush-mounted cabinets and panelboards in stud walls.

G. Identify electrical distribution and control equipment, and loads served, to meet regulatory requirements and as indicated.
1. Degrease and clean surfaces to receive nameplates and tape labels.
2. Secure nameplates to equipment fronts using screws, rivets, or adhesive, with edges parallel to equipment lines. Secure nameplate to inside face of recessed panelboard doors in finished locations.
3. Use nameplates with 1/8 inch lettering to identify individual switches and circuit breakers, wall switches, receptacle circuits, and loads served.
4. Use nameplates with 1/4 inch lettering to identify distribution and control equipment.

H. Install wire markers on each conductor in panelboard gutters, pull boxes, and at load connections.
1. Use branch circuit or feeder number to identify power and lighting circuits.
2. Use control wire number as indicated on equipment manufacturer's shop drawings to identify control wiring.

END OF SECTION

SECTION 26 0519

LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

WIRING DEVICES AND PLATES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Wire and cable.

B. Wiring devices.

C. Service fittings.

1.02 SUBMITTALS

Product Data:

A. Provide wiring device configurations, ratings, dimensions, and color selections.

B. Provide service fitting configurations, dimensions, and finish and color selections.

1.03 QUALITY ASSURANCE

A. Perform Work in accordance with NECA Standard of Installation.

1.04 REGULATORY REQUIREMENTS

A. Conform to requirements of NFPA 70.

B. Furnish products listed by UL or other testing firm acceptable to authority having jurisdiction.

PART 2 PRODUCTS

2.01 WIRING METHODS

A. Concealed Interior Locations: Building wire in raceway.

B. Exposed Interior Locations: Building wire in raceway.

C. Above Ceilings:

1. Building wire in raceway.
2. Metal Clad Cable Type MC cable for fixture whips only.

D. Wet or Damp Interior Locations: Building wire in raceway.

E. Exterior Locations: Building wire in raceways.

F. Use no wire smaller than 12 AWG conductor for all 15 ampere and 20 ampere circuits for power and lighting circuits, and no smaller than 18 AWG for control wiring. Use 10 AWG conductor for 20 ampere, 120 volt branch circuit home runs longer than 75 feet.

2.02 WIRE AND CABLE

A. Manufacturers:

1. Southwest
2. Essex
3. Southwire
4. Approved Equal

B. Building Wire:

1. Feeders and Branch Circuits Larger Than 6 AWG: Copper, stranded conductor, 600 volt insulation, THHN/THWN.
2. Feeders and Branch Circuits 6 AWG and Smaller: Copper conductor, 600 volt insulation, THHN/THWN. 6 and 8 AWG, stranded conductor; smaller than 8 AWG, solid conductor.
3. Control Circuits: Copper, stranded conductor, 600 volt insulation, THWN/THHN.

4. Minimum wire size for all branch circuits, #12 Copper THHN.

C. Armored Cable: NOT ALLOWED

D. METAL CLAD CABLE:

1. Description: ANSI/NFPA 70, Type MC.
2. Conductor: Copper
3. Insulation Voltage Rating: 600 volts.
4. Insulation Temperature Rating: 90 degrees C.
5. Insulation Material: Thermoplastic
6. Armor Material: Steel.
7. Armor Design: Interlocked metal tape or Corrugated tube.
8. Jacket: PVC, in locations specified.

E. Remote Control and Signal Cable:

1. Control Cable for Class 1 Remote control and Signal Circuits: Copper conductor, 600 volt insulation, rated 60 degree C, individual conductors twisted together, and covered with PVC jacket.
2. Control Cable for Class 2 or Class 3 Remote Control and Signal Circuits: Copper conductor, 300 volt insulation, rated 60 degree C, individual conductors twisted together, shielded, and covered with PVC jacket; UL listed.
3. Plenum Cable for Class 2 or Class 3 Remote Control and Signal Circuits: Copper conductor, 300 volt insulation, rated 60 degree C, individual conductors twisted together, shielded, and covered with non-metallic jacket; UL listed for use in air handling ducts, hollow spaces used as ducts, and plenums.

2.03 WIRING DEVICES AND WALL PLATES

A. Single Pole Switch:

1. Hubbell, Leviton, Pass & Seymour
2. Approved Equal.

B. Double Pole Switch:

1. Hubbell, Leviton, Pass & Seymour
2. Approved Equal.

C. Three-way Switch:

1. Hubbell, Leviton, Pass & Seymour
2. Approved Equal.

D. Four-way Switch:

1. Hubbell, Leviton, Pass & Seymour
2. Approved Equal.

E. Duplex Convenience Receptacle:

1. Hubbell, Leviton, Pass & Seymour
2. Approved Equal.

F. GFCI receptacle:

1. Hubbell, Leviton, Pass & Seymour
2. Approved Equal.

G. Telephone Jack:

As indicated on the drawings.

H. Cover Plate:

Description: Nylon fabricated cover plates in finished areas. Leviton or other approved by the architect. Finish selection by Architect.

I. Weatherproof Cover Plate:

Description: Gasketed cast metal with hinged gasketed device “while-in-use” cover.

PART 3 EXECUTION

3.01 EXAMINATION AND PREPARATION

A. Verify that interior of building is physically protected from weather.

B. Verify that mechanical work which is likely to injure conductors has been completed.

C. Completely and thoroughly swab raceway system before installing conductors.

3.02 INSTALLATION

A. Neatly train and secure wiring inside boxes, equipment, and loadcenters.

B. Use wire pulling lubricant for pulling 4 AWG and larger wires.

C. Make splices, taps, and terminations to carry full ampacity of conductors without perceptible temperature rise.

D. Install wiring devices in accordance with manufacturer's instructions.

1. Install wall switches 44” to centerline above floor, OFF position down.
2. Install wall dimmers 44” to centerline above floor. Derate ganged dimmers as instructed by manufacturer. Do not use common neutral.
3. Install convenience receptacles 16” to centerline above floor, 6 inches above counters, backsplash, grounding pole on top.
4. Install specific purpose receptacles at heights shown on Drawings.
5. Install cord and attachment plug caps on equipment under the provisions of Section 26 0500. Size the cord for connected load and rating of branch circuit overcurrent protection.

H. Install wall plates flush and level.

1. Install decorative plates on switch, receptacle, and blank outlets in finished areas.

END OF SECTION

SECTION 26 0526

GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. This Section includes methods and materials for grounding systems and equipment.

B. The conduit systems and neutral conductors of the wiring system shall be grounded. The ground connection of the electrical system, neutral ground wire system and conduit system shall be made at the main service device. The incoming cold water system, primary ground, neutral conduit system and metallic grounding system shall be bonded.

1.03 SUBMITTALS

A. Product Data: For each type of product indicated.

1.04 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with UL 467 for grounding and bonding materials and equipment.

PART 2 - PRODUCTS

2.01 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. Stranded Conductors: ASTM B 8.
3. Bonding Conductor: Conductor size per the construction documents or as required by NEC Article 250.

2.02 CONNECTORS

A. Listed and labeled by a nationally recognized testing laboratory 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, bolted pressure-type, with at least two bolts.

1. Pipe Connectors: Clamp type, sized for pipe.

C. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

2.03 GROUNDING ELECTRODES

A. Ground Rods: Copper-clad steel; 5/8 by 96 inches (16 by 2400 mm) in diameter.

PART 3 - EXECUTION

3.01 APPLICATIONS

A. Conductors: Install solid conductor for No. 8 AWG and smaller, and stranded conductors for No. 6 AWG and larger, unless otherwise indicated.

B. Underground Grounding Conductors: Install bare copper conductor, No. 2/0 AWG minimum.

1. Bury at least 30 inches (750 mm) below grade.

C. Conductor Terminations and Connections:

1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
2. Underground Connections: Welded connectors, except as otherwise indicated.
3. Connections to Ground Rods: Bolted connectors.
4. Connections to Structural Steel: Welded connectors.

3.02 EQUIPMENT GROUNDING

A. Install insulated equipment grounding conductors with all feeders and branch circuits.

3.03 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. Ground Rods: Drive rods until tops are 2 inches (50 mm) below finished floor or final grade, unless otherwise indicated.

1. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating, if any.
2. For grounding electrode system, install at least two rods spaced at least one-rod length from each other and located at least the same distance from other grounding electrodes, and connect to the service grounding electrode conductor.

C. 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 so vibration is not transmitted to rigidly mounted equipment.
3. Use exothermic-welded connectors for outdoor locations, but if a disconnect-type connection is required, use a bolted clamp.

D. Grounding and Bonding for Piping:

1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes, using a bolted clamp connector or by bolting a lug-type connector to a pipe flange, using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.
3. Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.

E. Ufer Ground (Concrete-Encased Grounding Electrode): Fabricate according to NFPA 70, using a minimum of 20 feet (6 m) of bare copper conductor not smaller than No. 2 AWG.

1. If concrete foundation is less than 20 feet (6 m) long, coil excess conductor within base of foundation.
2. Bond grounding conductor to reinforcing steel in at least four locations and to anchor bolts. Extend grounding conductor below grade and connect to building grounding grid or to grounding electrode external to concrete.

3.04 FIELD QUALITY CONTROL

A. Report measured ground resistances that exceed the following values:

1. Power and Lighting Equipment or System with Capacity 500 kVA and Less: 10 ohms.
2. Power and Lighting Equipment or System with Capacity 500 to 1000 kVA: 5 ohms.
3. Power and Lighting Equipment or System with Capacity More Than 1000 kVA: 3 ohms.

B. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.

END OF SECTION

SECTION 26 0529

HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. This Section includes the following:

1. Hangers and supports for electrical equipment and systems.
2. Construction requirements for concrete bases.

1.03 DEFINITIONS

A. EMT: Electrical metallic tubing.

B. IMC: Intermediate metal conduit.

C. RMC: Rigid metal conduit.

1.04 PERFORMANCE REQUIREMENTS

A. Design supports for multiple raceways capable of supporting combined weight of supported systems and its contents.

B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

C. Rated Strength: Adequate in tension, shear, and pullout force to resist maximum loads calculated or imposed for this Project, with a minimum structural safety factor of five times the applied force.

1.05 SUBMITTALS

A. Product Data: For the following:

1. Steel slotted support systems.

B. Shop Drawings: Show fabrication and installation details and include calculations for the following:

1. Trapeze hangers. Include Product Data for components.
2. Steel slotted channel systems. Include Product Data for components.
3. Equipment supports.

1.06 QUALITY ASSURANCE

A. Comply with NFPA 70.

1.07 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

B. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 07 Section "Roof Accessories."

PART 2 - PRODUCTS

2.01 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, provide products by one of the following:

a. Allied Tube & Conduit.

b. Cooper B-Line, Inc.; a division of Cooper Industries.
c. ERICO International Corporation.
d. GS Metals Corp.
e. Thomas & Betts Corporation.
f. Unistrut; Tyco International, Ltd.
g. Wesanco, Inc.
h. Engineer approved equal.

2. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
3. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
4. Channel Dimensions: Selected for applicable load criteria.

B. Raceway and Cable Supports: As described in NECA 1 and NECA 101.

C. Conduit and Cable Support Devices: Steel and malleable-iron hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.

D. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for non-armored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be malleable iron.

E. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

F. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:

1. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
   a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      1) Hilti Inc.
      2) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
      3) MKT Fastening, LLC.
      4) Simpson Strong-Tie Co., Inc.; Masterset Fastening Systems Unit.
      5) Engineer approved equal.
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 in which used.
   a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      1) Cooper B-Line, Inc.; a division of Cooper Industries.
      2) Empire Tool and Manufacturing Co., Inc.
      3) Hilti Inc.
      4) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
      5) MKT Fastening, LLC.
      6) Engineer approved equal.
3. Concrete Inserts: Steel or malleable-iron, slotted support system units similar to MSS Type 18; complying with MFMA-4 or MSS SP-58.

4. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.
5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
6. Toggle Bolts: All-steel springhead type.
7. Hanger Rods: Threaded steel.

PART 3 - EXECUTION

3.01 APPLICATION

A. Comply with NECA 1 and NECA 101 for application of hangers and supports for electrical equipment and systems except if requirements in this Section are stricter.

B. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMT, IMC, and RMC as required by NFPA 70. Minimum rod size shall be 1/4 inch in diameter.

C. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted or other support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.

1. Secure raceways and cables to these supports with single-bolt conduit clamps using spring friction action for retention in support channel.

3.02 SUPPORT INSTALLATION

A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this Article.

B. Raceway Support Methods: In addition to methods described in NECA 1, EMT, IMC, and RMC may be supported by openings through structure members, as permitted in NFPA 70.

C. 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.

D. 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. To Steel: Welded threaded studs complying with AWS D1.1/D1.1M, with lock washers and nuts, beam clamps (MSS Type 19, 21, 23, 25, or 27) complying with MSS SP-69, or spring-tension clamps.
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.

E. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.

3.03 INSTALLATION OF FABRICATED METAL SUPPORTS

A. Comply with installation requirements in Division 05 Section "Metal Fabrications" for site-fabricated metal supports.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.

C. Field Welding: Comply with AWS D1.1/D1.1M.

3.04 CONCRETE BASES

A. Construct concrete bases of dimensions indicated but not less than 4 inches (100 mm) 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 (20.7-MPa), 28-day compressive-strength concrete. Concrete materials, reinforcement, and placement requirements are specified in Division 03 Section "Cast-in-Place Concrete."

C. Anchor equipment to concrete base.

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.

3.05 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.

4. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils (0.05 mm).

B. Touchup: Comply with requirements in Division 09 painting Sections for 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 A 780.

END OF SECTION

SECTION 26 0533

RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Conduit and fittings.
B. Wireway.
C. Electrical boxes.
D. Service fittings.

1.02 REGULATORY REQUIREMENTS

A. Conform to requirement of ANSI/NFPA 70.
B. Furnish products listed by Underwriters Laboratories, Inc. or other testing firm acceptable to authority having jurisdiction.

PART 2 PRODUCTS

2.01 PRODUCT REQUIREMENTS

A. Use only specified raceway in the following locations:
   1. Underground Installations More than Five Feet From Foundation Wall: Plastic conduit.
   2. Installations In or Under Concrete Slab, or Underground Within Five Feet From Foundation Wall: Rigid steel conduit or Plastic conduit.
   3. In Slab Above Grade: Plastic conduit, 3/4 inch maximum size, 1/2 inch where crossing each other.
   4. Exposed Outdoor Locations: Intermediate Metal Conduit or Electrical metallic tubing. Use threaded or rain tight fittings.
   5. Wet Interior Locations: Electrical metallic tubing. Use threaded or raintight fittings for metal conduit.
   6. Concealed Dry Interior Locations: Electrical metallic tubing.
   7. Exposed Dry Interior Locations: Electrical metallic tubing.

B. Size raceways for conductor type installed or for type THWN conductors, whichever is larger.

   Minimum Size Conduit: 1/2-inch.

2.02 CONDUIT AND FITTINGS

A. Conduit:
   1. Metal Conduit and Tubing: Galvanized steel.
   2. Flexible Conduit: Steel.
   3. Liquidtight Flexible Conduit: Flexible conduit with PVC jacket.
   4. Plastic Conduit and Tubing: NEMA TC 2; PVC. Use Schedule 40 conduit.

B. Conduit Fittings:
   1. Metal Fittings and Conduit Bodies: NEMA FB 1.
   2. Plastic Fittings and Conduit Bodies: NEMA TC 3.

2.03 ELECTRICAL BOXES

A. Boxes:
   1. Sheet Metal: NEMA OS 1; Galvanized steel.
   2. Cast Metal: Cast alloy, deep type, gasket cover, threaded hubs.
   3. Nonmetallic: NEMA OS 2.

B. Hinged Cover Enclosures: NEMA 250; Type 1, steel enclosure with manufacturer's standard enamel finish and continuous hinge cover, held closed by flush latch operable by screwdriver.

PART 3 EXECUTION

3.01 EXAMINATION AND PREPARATION

A. Verify that supporting surfaces are ready to receive work.

B. Electrical boxes are shown on Drawings, in approximate locations, unless dimensioned.

   Obtain verification from Architect/Engineer and Owner of box locations, and locations of outlets in offices and work areas, prior to rough-in.

3.02 INSTALLATION

A. Install electrical boxes as shown on the drawings, and as required for splices, taps, wire pulling, equipment connections and regulatory requirements.
   1. Use cast outlet box in exterior locations and wet locations.
   2. Use hinged cover enclosure for interior pull and junction box larger than 12 inches in any dimension.
   3. Locate and install electrical boxes to allow access. Provide access panels if required.
   4. Locate and install electrical boxes to maintain headroom and to present neat mechanical appearance.
   5. Install pull boxes and junction boxes above accessible ceilings or in unfinished areas.
   6. Provide knockout closures for unused openings.
   7. Align wall-mounted outlet boxes for switches, thermostats, and similar devices.
   8. Coordinate mounting heights and locations of outlets above counters, benches, and backsplashes.
   9. Install lighting outlets to locate luminaries as shown on reflected ceiling plan.

B. Use recessed outlet boxes in finished areas and where indicated.
   1. Secure boxes to interior wall and partition studs, accurately positioning to allow for surface finish thickness.
   2. Do not install boxes back-to-back in walls; provide 6 inches separation, minimum; except provide 24 inches separation, minimum in acoustic-rated walls.
   3. Do not damage insulation.

C. Conduit Fittings and Connectors.
   1. EMT conduit fittings to be compression type.
   2. No set-screw type connector fittings will be allowed.
   3. IMC and RMC conduit fittings to be threaded couplings.

END OF SECTION

SECTION 26 0553

IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes:

1. Identification for raceways.
2. Identification of power and control cables.
3. Identification for conductors.
4. Underground-line warning tape.
5. Warning labels and signs.
6. Instruction signs.
7. Equipment identification labels.
8. Miscellaneous identification products.

1.03 SUBMITTALS

A. Product Data: For each electrical identification product indicated.

1.04 QUALITY ASSURANCE

A. Comply with ANSI A13.1 and IEEE C2.

B. Comply with NFPA 70.

1.05 COORDINATION

A. Coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual; and with those required by codes and standards. Use consistent designations throughout Project.

B. Coordinate installation of identifying devices with completion of covering and painting 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.

PART 2 - PRODUCTS

2.01 CONDUCTOR IDENTIFICATION MATERIALS

A. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape not less than 3 mils (0.08 mm) thick by 1 to 2 inches (25 to 50 mm) wide.

2.02 FLOOR MARKING TAPE

A. 2-inch- (50-mm-) wide, 5-mil (0.125-mm) pressure-sensitive vinyl tape, with black and white stripes and clear vinyl overlay.

2.03 UNDERGROUND-LINE WARNING TAPE

A. Tape:

1. Recommended by manufacturer for the method of installation and suitable to identify and locate underground electrical utility lines.
2. Printing on tape shall be permanent and shall not be damaged by burial operations.
3. Tape material and ink shall be chemically inert, and not subject to degrading when exposed to acids, alkalis, and other destructive substances commonly found in soils.

2.04 WARNING LABELS AND SIGNS

A. Comply with NFPA 70 and 29 CFR 1910.145.

B. Self-Adhesive Warning Labels: Factory-printed, multicolor, pressure-sensitive adhesive labels, configured for display on front cover, door, or other access to equipment unless otherwise indicated.

C. Warning label and sign shall include, but are not limited to, the following legends:

1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."
2. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES (915 MM)."
3. As directed by Architect and/or Engineer.

2.05 EQUIPMENT IDENTIFICATION LABELS

A. Adhesive Film Label: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch (10 mm).

B. Self-Adhesive, Engraved, Laminated Acrylic or Melamine Label: Adhesive backed, with white letters on a dark-gray background. Minimum letter height shall be 3/8 inch (10 mm).

C. Engraved, Laminated Acrylic or Melamine Label: Punched or drilled for screw mounting. White letters on a dark-gray background. Minimum letter height shall be 3/8 inch (10 mm).

2.06 CABLE TIES

A. General-Purpose Cable Ties: Fungus inert, self extinguishing, one piece, self locking, Type 6/6 nylon.

1. Minimum Width: 3/16 inch (5 mm).
2. Tensile Strength at 73 deg F (23 deg C), According to ASTM D 638: 12,000 psi (82.7 MPa).
3. Temperature Range: Minus 40 to plus 185 deg F (Minus 40 to plus 85 deg C).
4. Color: Black except where used for color-coding.

B. UV-Stabilized Cable Ties: Fungus inert, designed for continuous exposure to exterior sunlight, self extinguishing, one piece, self locking, Type 6/6 nylon.

1. Minimum Width: 3/16 inch (5 mm).
2. Tensile Strength at 73 deg F (23 deg C), According to ASTM D 638: 12,000 psi (82.7 MPa).
3. Temperature Range: Minus 40 to plus 185 deg F (Minus 40 to plus 85 deg C).
4. Color: Black.

C. Plenum-Rated Cable Ties: Self extinguishing, UV stabilized, one piece, self locking.

1. Minimum Width: 3/16 inch (5 mm).
2. Tensile Strength at 73 deg F (23 deg C), According to ASTM D 638: 7000 psi (48.2 MPa).
3. UL 94 Flame Rating: 94V-0.
4. Temperature Range: Minus 50 to plus 284 deg F (Minus 46 to plus 140 deg C).
5. Color: Black.

2.07 MISCELLANEOUS IDENTIFICATION PRODUCTS

A. Paint: Comply with requirements in Division 09 painting Sections for paint materials and application requirements. Select paint system applicable for surface material and location (exterior or interior).

B. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Verify identity of each item before installing identification products.

B. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.

C. Apply identification devices to surfaces that require finish after completing finish work.

D. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.

E. Attach signs and plastic labels that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.

F. System Identification Color-Coding Bands for Raceways and Cables: Each color-coding band shall completely encircle cable or conduit. Place adjacent bands of two-color markings in contact, side by side. Locate bands 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.

G. Underground-Line Warning Tape: During backfilling of trenches install continuous underground-line warning tape directly above line at 6 to 8 inches below finished grade. Use multiple tapes where width of multiple lines installed in a common trench exceeds 16 inches overall.

H. Painted Identification: Comply with requirements in Division 09 painting Sections for surface preparation and paint application.

3.02 IDENTIFICATION SCHEDULE

A. Concealed Raceways, Duct Banks, More Than 600 V, within Buildings: Tape and stencil 4-inch- wide black stripes on 10-inch centers over orange background that extends full length of raceway or duct and is 12 inches wide. Stencil legend "DANGER CONCEALED HIGH VOLTAGE WIRING" with 3-inch- high black letters on 20-inch centers. Stop stripes at legends. Apply to the following finished surfaces:

1. Floor surface directly above conduits running beneath and within 12 inches of a floor that is in contact with earth or is framed above unexcavated space.
2. Wall surfaces directly external to raceways concealed within wall.
3. Accessible surfaces of concrete envelope around raceways in vertical shafts, exposed in the building, or concealed above suspended ceilings.

B. Power-Circuit Conductor Identification, 600 V or Less: For conductors in vaults, pull and junction boxes, manholes, and handholes, use color-coding conductor tape to identify the phase.

1. Color-Coding for Phase and Voltage Level Identification, 600 V or Less: Use colors listed below for ungrounded service, feeder and branch-circuit conductors.
    a. Color shall be factory applied or field applied for sizes larger than No. 8 AWG, if authorities having jurisdiction permit.
    b. Colors for 208/120-V Circuits:
        1) Phase A: Black.
        2) Phase B: Red.
        3) Phase C: Blue.
    c. Colors for 480/277-V Circuits:
        1) Phase A: Brown.
        2) Phase B: Orange.
        3) Phase C: Yellow.

d. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Locate bands to avoid obscuring factory cable markings.

C. Install instructional sign including the color-code for grounded and ungrounded conductors using adhesive-film-type labels.

D. Workspace Indication: Install floor marking tape to show working clearances in the direction of access to live parts. Workspace shall be as required by NFPA 70 and 29 CFR 1926.403 unless otherwise indicated. Do not install at flush-mounted panelboards and similar equipment in finished spaces.

E. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and the Operation and Maintenance Manual. Apply labels to disconnect switches and protection equipment, central or master units, control panels, control stations, terminal cabinets, and racks of each system. Systems include power, lighting, control, communication, signal, monitoring, and alarm systems unless equipment is provided with its own identification.

1. Labeling Instructions:

a. Indoor Equipment: Adhesive film label. Unless otherwise indicated, provide a single line of text with 1/2-inch- (13-mm-) high letters on 1-1/2-inch- (38-mm-) high label; where two lines of text are required, use labels 2 inches (50 mm) high.

b. Outdoor Equipment: Engraved, laminated acrylic or melamine label.

c. Elevated Components: Increase sizes of labels and letters to those appropriate for viewing from the floor.

d. Unless provided with self-adhesive means of attachment, fasten labels with appropriate mechanical fasteners that do not change the NEMA or NRTL rating of the enclosure.

2. Equipment to Be Labeled:

a. Panelboards: Typewritten directory of circuits in the location provided by panelboard manufacturer. Panelboard identification shall be self-adhesive, engraved, laminated acrylic or melamine label.

b. Enclosures and electrical cabinets.

c. Access doors and panels for concealed electrical items.

d. Switchgear.

e. Switchboards.

f. Transformers: Label that includes tag designation shown on Drawings for the transformer, feeder, and panelboards or equipment supplied by the secondary.

g. Enclosed switches.

h. Enclosed circuit breakers.

i. Enclosed controllers.

j. Variable-speed controllers.

k. Push-button stations.

l. Power transfer equipment.

m. Contactors.

n. Remote-controlled switches, dimmer modules, and control devices.

o. Receptacles (on front of coverplate).

3. Identify Raceways of Certain Systems with Color Banding: Band exposed or accessible raceways of the following systems for identification. Bands shall be pretensioned, snap-a-round, colored plastic sleeves, colored adhesive marking tape, or a combination of the

two. Make each color band 2 inches wide, completely encircling conduit, and place adjacent bands of two-color markings in contact, side by side. Install bands at changes in direction, at penetrations of walls and floors, and at 40-foot maximum intervals in straight runs. Apply the following colors:

a. Fire Alarm System: Red

b. Security Alarm Systems: Blue and Yellow

c. Mechanical and Electrical Supervisory System: Green and Blue

d. Data System: Green and Yellow

e. TV Systems: Green

f. Sound/PA: Orange

g. Telephone: Orange and Yellow

h. 120/208V Power: Black

i. 277/480V Power: Blue

j. 120/208V Emergency Power: Black and Orange

k. 277/480V Emergency Power: Blue and Orange

4. Identify Junction, Pull, and Connection Boxes: Code-required caution sign for boxes shall be pressure-sensitive, self-adhesive label indicating system voltage in black, preprinted on orange background. Install on outside of box cover. Also label box covers with identity of contained circuits. Use pressure-sensitive plastic labels at exposed locations or similar labels.

5. Use conductors with color factory-applied the entire length of the conductors except as follows under which conditions field applied color-coding methods may be used in lieu of factory-coded sire for sizes larger than No. 10 AWG:

   a. Apply colored, pressure-sensitive plastic tape in half–lapped turns for a distance of 6 inches from terminal points and in boxes where splices or taps are made. Apply the last two laps of tape with no tension to prevent possible unwinding. Use 1-inch- wide tape in colors as specified. Do not obliterate cable identification markings by taping. Tape locations may be adjusted slightly to prevent such obliteration.

6. Tag or label conductors as follows:

   a. Future Connections: Conductors indicated to be for future connection or connection under another contract with identification indicating source and circuit numbers.

   b. Multiple Circuits: Where multiple branch circuits or control wiring or communications/signal conductors are present in the same box or enclosure, label each conductor or cable. Provide legend indicating source, voltage, circuit number, and phase for branch circuit wiring. Phase and voltage of branch circuit wiring may be indicated by means of coded color of conductor insulation. For control and communications/signal wiring, use color coding or wire/cable marking tape at terminations and at intermediate locations where conductors appear in wiring boxes, troughs, and control cabinets. Use consistent letter/number conductor designations throughout on wire/cable marking tapes.

   c. Fiber Optic Cable and conduit: All fiber optic cable shall bear factory printed cable identification marking indicating the cable is “fiber optic”. Install permanent ink markings indicating the words “fiber optic” on colored tape or tags to this effect on conduit runs containing fiber optic cable at changes in direction, at penetrations of walls and floors (each side), at junction boxes and termination, and at 40 foot maximum intervals.

END OF SECTION

SECTION 26 2200
LOW-VOLTAGE TRANSFORMERS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. This Section includes the following types of dry-type transformers rated 600 V and less, with capacities up to 1000 kVA:

1. Distribution Transformers.
    a. Transformers shall deliver 48% less losses across the kVA load range than transformers designed to NEMA TP1/EPACT2005.
    b. Transformers shall deliver 24% less losses across the kVA load range than transformers designed to NEMA Premium, CEE Tier 1, or CSL3.

1.03 SUBMITTALS

A. Product Data: Include rated nameplate data, capacities, weights, dimensions, minimum clearances, installed devices and features, and performance for each type and size of transformer indicated.

B. 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. Wiring Diagrams: Power, signal, and control wiring.

C. Manufacturer Seismic Qualification Certification: Submit certification that transformers, accessories, and components will withstand seismic forces defined in Division 26 Section "Vibration and Seismic Controls for Electrical Systems." Include the following:

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
    a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."
    b. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

D. Qualification Data: For testing agency.

E. Source quality-control test reports.

F. Field quality-control test reports.

G. Operation and Maintenance Data: For transformers to include in emergency, operation, and maintenance manuals.

1.04 QUALITY ASSURANCE

A. If an independent testing agency is required, see Division 01 Section "Quality Requirements" for general testing and inspecting agency qualification requirements. If additional control is needed, retain one of first two paragraphs below to specify 29 CFR 1910.7 or other more specific criteria (e.g., NETA). 29 CFR 1910.7 defines a nationally recognized testing laboratory

as it applies to testing and inspecting for safety, and lists, labels, or accepts equipment and materials that meet certain OSHA criteria.

B. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.

1. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association or the National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.

C. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7.

D. Source Limitations: Obtain each transformer type through one source from a single manufacturer.

E. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

F. Comply with IEEE C57.12.91, "Test Code for Dry-Type Distribution and Power Transformers."

1.05 DELIVERY, STORAGE, AND HANDLING

A. Temporary Heating: Apply temporary heat according to manufacturer's written instructions within the enclosure of each ventilated-type unit, throughout periods during which equipment is not energized and when transformer is not in a space that is continuously under normal control of temperature and humidity.

1.06 COORDINATION

A. Coordinate size and location of concrete bases with actual transformer provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

B. Coordinate installation of wall-mounting and structure-hanging supports with actual transformer provided.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Powersmiths International.
    a. ESaver-2016-HP Series
2. Engineer Approved Equals.

2.02 GENERAL TRANSFORMER REQUIREMENTS

A. Description: Factory-assembled and -tested, air-cooled units for 60-Hz service.

B. Cores: Grain-oriented, non-aging silicon steel.

C. Coils: Continuous windings without splices except for taps.

1. Internal Coil Connections: Brazed or pressure type.
2. Coil Material: Copper.

2.03 DISTRIBUTION TRANSFORMERS

A. Comply with NEMA ST 20, and list and label as complying with UL 1561.

B. Provide transformers that are constructed to withstand seismic forces specified in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."

C. Cores: One leg per phase.

D. Enclosure: Ventilated, NEMA 250, Type 2.

1. Core and coil shall be encapsulated within resin compound, sealing out moisture and air.

E. Enclosure: Ventilated, NEMA 250, Type 3R.

1. Core and coil shall be encapsulated within resin compound, sealing out moisture and air.

F. Transformer Enclosure Finish: Comply with NEMA 250.

1. Finish Color: Gray.

G. Taps for Transformers 25 kVA and Larger: Two 2.5 percent taps above and two 2.5 percent taps below normal full capacity.

H. Insulation Class: 220 deg C, UL-component-recognized insulation system with a maximum of 150 deg C rise above 40 deg C ambient temperature.

I. Energy Efficiency for Transformers Rated 15 kVA and Larger:

1. Complying with NEMA TP 1, Class 1 efficiency levels.

2. Tested according to NEMA TP 2.

J. K-Factor Rating: Transformers indicated to be K-factor rated shall comply with UL 1561 requirements for nonsinusoidal load current-handling capability to the degree defined by designated K-factor.

1. Unit shall not overheat when carrying full-load current with harmonic distortion corresponding to designated K-factor.

2. Indicate value of K-factor on transformer nameplate.

K. Electrostatic Shielding: Each winding shall have an independent, single, full-width copper electrostatic shield arranged to minimize interwinding capacitance.

1. Arrange coil leads and terminal strips to minimize capacitive coupling between input and output terminals.

2. Include special terminal for grounding the shield.

3. Shield Effectiveness:

a. Capacitance between Primary and Secondary Windings: Not to exceed 33 picofarads over a frequency range of 20 Hz to 1 MHz.

b. Common-Mode Noise Attenuation: Minimum of minus 120 dBA at 0.5 to 1.5 kHz; minimum of minus 65 dBA at 1.5 to 100 kHz.

c. Normal-Mode Noise Attenuation: Minimum of minus 52 dBA at 1.5 to 10 kHz.

J. Wall Brackets: Manufacturer's standard brackets.

K. Fungus Proofing: Permanent fungicidal treatment for coil and core.

2.04 IDENTIFICATION DEVICES

A. Nameplates: Engraved, laminated-plastic or metal nameplate for each distribution transformer, mounted with corrosion-resistant screws. Nameplates and label products are specified in Division 26 Section "Identification for Electrical Systems."

2.05 SOURCE QUALITY CONTROL

A. Test and inspect transformers according to IEEE C57.12.91.

B. Factory Sound-Level Tests: Conduct sound-level tests on equipment for this Project.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine conditions for compliance with enclosure- and ambient-temperature requirements for each transformer.

B. Verify that field measurements are as needed to maintain working clearances required by NFPA 70 and manufacturer's written instructions.

C. Examine walls, floors, roofs, and concrete bases for suitable mounting conditions where transformers will be installed.

D. Verify that ground connections are in place and requirements in Division 26 Section "Grounding and Bonding for Electrical Systems" have been met. Maximum ground resistance shall be 5 ohms at location of transformer.

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

3.02 INSTALLATION

A. Install wall-mounting transformers level and plumb with wall brackets fabricated by transformer manufacturer.

1. Brace wall-mounting transformers as specified in Division 26 Section "Vibration and Seismic Controls for Electrical Systems.

B. Construct concrete bases and anchor floor-mounting transformers according to manufacturer's written instructions and requirements in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."

3.03 CONNECTIONS

A. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

B. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.04 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections. Report results in writing.

B. Perform tests and inspections and prepare test reports.

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. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.

D. Remove and replace units that do not pass tests or inspections and retest as specified above.

E. Infrared Scanning: Two months after Substantial Completion, perform an infrared scan of transformer connections.

1. Use an infrared-scanning device designed to measure temperature or detect significant deviations from normal values. Provide documentation of device calibration.

2. Perform 2 follow-up infrared scans of transformers, one at 4 months and the other at 11 months after Substantial Completion.

3. Prepare a certified report identifying transformer checked and describing results of scanning. Include notation of deficiencies detected, remedial action taken, and scanning observations after remedial action.

F. Test Labeling: On completion of satisfactory testing of each unit, attach a dated and signed "Satisfactory Test" label to tested component.

3.05 ADJUSTING

A. Record transformer secondary voltage at each unit for at least 48 hours of typical occupancy period. Adjust transformer taps to provide optimum voltage conditions at secondary terminals. Optimum is defined as not exceeding nameplate voltage plus 10 percent and not being lower

than nameplate voltage minus 3 percent at maximum load conditions. Submit recording and tap settings as test results.

3.06 CLEANING

A. Vacuum dirt and debris; do not use compressed air to assist in cleaning.

END OF SECTION

SECTION 26 2416

PANELBOARDS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Service entrance and metering.

B. Enclosed switches.

C. Grounding.

D. Panelboards.

E. Fuses.

1.02 SYSTEM DESCRIPTION

Electric Service System: 277/480V, 3 phase, 4 wire.

1.03 SUBMITTALS

A. Shop Drawings: Indicate relevant information on panelboards.

B. Product Data: Provide data on enclosed switches and circuit breakers, fuses and circuit breakers.

C. Operating and Maintenance Instructions:

1. Panelboards : Submit NEMA PB 2.1.

1.04 REGULATORY REQUIREMENTS

A. Conform to requirements of Utility Company.

B. Contractor shall be responsible for final coordination with utility companies regarding new electrical service. Verify exact requirements prior to rough-in. There shall be no extra costs to the owner for contractor's failure to coordinate utility requirements.

PART 2 PRODUCTS

2.01 METERING EQUIPMENT - Per Utility Specification

2.02 ENCLOSED SWITCHES

A. Manufacturers:

1. Eaton

2. Engineer approved equal.

B. Enclosed Switch Assemblies: NEMA KS 1; Type General Duty.

Fuse clips: Designed to accommodate Class R fuses.

C. Enclosures: NEMA KS 1; Type as indicated on Drawings.

2.03 FUSES

A. Manufacturers:

1. Bussman

2. Gould

B. Fuses 600 Amperes and Less: Dual element, current limiting, time delay, one-time fuse, 250 volt, UL Class RK 1.

2.04 GROUNDING MATERIALS

A. Ground Rods: Copper-encased steel, 5/8 inch diameter, minimum length 10 feet.

B. Clamps: Bronze.

2.05 PANELBOARDS

A. Manufacturers:

1. Eaton.
2. Engineer approved equal.

B. Load Centers: Circuit breaker load center.

1. Enclosure: As scheduled on the drawings.
2. Provide flush or surface box, with door, and with pull ring and latch on door.
3. Provide panelboards with bus ratings as scheduled on Drawings.
4. Do not use tandem circuit breakers.
5. Voltage: 120208 volts, three phase.
6. Minimum Integrated Equipment Rating: 10,000 amperes rms symmetrical.

C. Accessories:

1. Provide circuit breaker accessories as indicated on Drawings.
2. Double latch, double lock, door-in-door construction.
3. No EZ trim door frame allowed.
4. No piano hinge door frame allowed.

PART 3 EXECUTION

3.01 EXAMINATION AND PREPARATION

A. Examine surfaces. Verify details and dimensions are as required.

B. Schedule site meeting with Utility to insure proper coordination. Notify architect in writing 7 days prior to meeting.

3.02 INSTALLATION

A. Install equipment in accordance with manufacturer's instructions.

B. Install proper fuses in each fused switch.

C. Verify grounding and bonding to NFPA 70.

1. Supplementary Grounding Electrode: Use driven ground rod on exterior of building in main service equipment area.
2. Provide separate, insulated equipment grounding conductor in feeder and branch circuits. Terminate each end on a grounding lug, bus, or bushing.
3. Use 6 AWG minimum size, copper conductor to bond communications system grounding conductor to nearest effectively grounded metallic water pipe.

D. Install loadcenters to NEMA PB 1.1.

3.03 FIELD QUALITY CONTROL

A. Inspect grounding and bonding system conductors and connections for tightness and proper installation.

B. Measure ground resistance from system neutral connection at service entrance to convenient ground reference point by passing minimum current of 10 amperes DC and measuring voltage drop. Maximum resistance: 10 ohms.

3.04 CLEANING

A. Clean equipment finishes to remove paint and concrete spatters.

END OF SECTION

SECTION 26 2726
WIRING DEVICES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. This Section includes the following:

1. Receptacles, receptacles with integral GFCI, and associated device plates.
2. Twist-locking receptacles.
3. Receptacles with integral surge suppression units.
4. Isolated-ground receptacles.
5. Snap switches and wall-box dimmers.
6. Solid-state fan speed controls.
7. Communications outlets.
8. Pendant cord-connector devices.
9. Cord and plug sets.
10. Floor service outlets, poke-through assemblies, service poles, and multioutlet assemblies.

1.03 DEFINITIONS

A. EMI: Electromagnetic interference.

B. GFCI: Ground-fault circuit interrupter.

C. Pigtail: Short lead used to connect a device to a branch-circuit conductor.

D. RFI: Radio-frequency interference.

E. TVSS: Transient voltage surge suppressor.

F. UTP: Unshielded twisted pair.

1.04 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Operation and Maintenance Data: For wiring devices to include in all manufacturers' packing label warnings and instruction manuals that include labeling conditions.

1.05 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with NFPA 70.

1.06 COORDINATION

A. Receptacles for Owner-Furnished Equipment: Match plug configurations.

1. Cord and Plug Sets: Match equipment requirements.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers' Names: Shortened versions (shown in parentheses) of the following manufacturers' names are used in other Part 2 articles:

1. Cooper Wiring Devices; a division of Cooper Industries, Inc. (Cooper).

2. Hubbell Incorporated; Wiring Device-Kellems (Hubbell).
3. Leviton Mfg. Company Inc. (Leviton).
4. Pass & Seymour/Legrand; Wiring Devices & Accessories (Pass & Seymour).
5. Engineer approved equal.

2.02 STRAIGHT BLADE RECEPTACLES

A. Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration 5-20R, and UL 498.
1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
2. Products: Subject to compliance with requirements, provide one of the following:
a. Cooper; 5351 (single), 5352 (duplex).
b. Hubbell; HBL5351 (single), CR5352 (duplex).
c. Leviton; 5891 (single), 5352 (duplex).
d. Pass & Seymour; 5381 (single), 5352 (duplex).
e. Engineer approved equal.

B. Tamper-Resistant Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration 5-20R, and UL 498.
1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
2. Products: Subject to compliance with requirements, provide one of the following:
a. Cooper; TR8300.
b. Hubbell; HBL8300SG.
c. Leviton; 8300-SGG.
d. Pass & Seymour; 63H.
e. Engineer approved equal.
3. Description: Labeled to comply with NFPA 70, "Health Care Facilities" Article, "Pediatric Locations" Section.

2.03 GFCI RECEPTACLES

A. General Description: Straight blade, feed-through type. Comply with NEMA WD 1, NEMA WD 6, UL 498, and UL 943, Class A, and include indicator light that is lighted when device is tripped.

B. Duplex GFCI Convenience Receptacles, 125 V, 20 A:
1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
2. Products: Subject to compliance with requirements, provide one of the following:
a. Cooper; GF20.
b. Pass & Seymour; 2084.
c. Engineer approved equal.

2.04 TVSS RECEPTACLES

A. General Description: Comply with NEMA WD 1, NEMA WD 6, UL 498, and UL 1449, with integral TVSS in line to ground, line to neutral, and neutral to ground.
1. TVSS Components: Multiple metal-oxide varistors; with a nominal clamp-level rating of 400 volts and minimum single transient pulse energy dissipation of 240 J, according to IEEE C62.41.2 and IEEE C62.45.

2. Active TVSS Indication: Visual and audible, with light visible in face of device to indicate device is "active" or "no longer in service."

B. Duplex TVSS Convenience Receptacles:

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

2. Products: Subject to compliance with requirements, provide one of the following:

a. Cooper; 5362BLS.

b. Hubbell; HBL5362SA.

c. Leviton; 5380.

d. Engineer approved equal.

3. Description: Straight blade, 125 V, 20 A; NEMA WD 6 configuration 5-20R.

2.05 TWIST-LOCKING RECEPTACLES

A. Single Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration L5-20R, and UL 498.

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

2. Products: Subject to compliance with requirements, provide one of the following:

a. Cooper; L520R.

b. Hubbell; HBL2310.

c. Leviton; 2310.

d. Pass & Seymour; L520-R.

e. Engineer approved equal.

2.06 PENDANT CORD-CONNECTOR DEVICES

A. Description: Matching, locking-type plug and receptacle body connector; NEMA WD 6 configurations L5-20P and L5-20R, heavy-duty grade.

1. Body: Nylon with screw-open cable-gripping jaws and provision for attaching external cable grip.

2. External Cable Grip: Woven wire-mesh type made of high-strength galvanized-steel wire strand, matched to cable diameter, and with attachment provision designed for corresponding connector.

2.07 CORD AND PLUG SETS

A. Description: Match voltage and current ratings and number of conductors to requirements of equipment being connected.

1. Cord: Rubber-insulated, stranded-copper conductors, with Type SOW-A jacket; with green-insulated grounding conductor and equipment-rating ampacity plus a minimum of 30 percent.

2. Plug: Nylon body and integral cable-clamping jaws. Match cord and receptacle type for connection.

2.08 SNAP SWITCHES

A. Comply with NEMA WD 1 and UL 20.

B. Switches, 120/277 V, 20 A:

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

2. Products: Subject to compliance with requirements, provide one of the following:

a. Cooper; 2221 (single pole), 2222 (two pole), 2223 (three way), 2224 (four way).

b. Hubbell; CS1221 (single pole), CS1222 (two pole), CS1223 (three way), CS1224 (four way).

c. Leviton; 1221-2 (single pole), 1222-2 (two pole), 1223-2 (three way), 1224-2 (four way).

d. Pass & Seymour; 20AC1 (single pole), 20AC2 (two pole), 20AC3 (three way), 20AC4 (four way).

e. Engineer approved equal.

C. Pilot Light Switches, 20 A:

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

2. Products: Subject to compliance with requirements, provide one of the following:

a. Cooper; 2221PL for 120 V and 277 V.

b. Hubbell; HPL1221PL for 120 V and 277 V.

c. Leviton; 1221-PLR for 120 V, 1221-7PLR for 277 V.

d. Pass & Seymour; PS20AC1-PLR for 120 V.

e. Engineer approved equal.

3. Description: Single pole, with neon-lighted handle, illuminated when switch is "ON."

D. Key-Operated Switches, 120/277 V, 20 A:

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

2. Products: Subject to compliance with requirements, provide one of the following:

a. Leviton; 1221-2L.

3. Description: Single pole, with factory-supplied key in lieu of switch handle.

2.09 WALL-BOX DIMMERS

A. Dimmer Switches: Modular, full-wave, solid-state units with integral, quiet on-off switches, with audible frequency and EMI/RFI suppression filters.

B. Control: Continuously adjustable slider; with single-pole or three-way switching. Comply with UL 1472.

C. Incandescent Lamp Dimmers: 120 V; control shall follow square-law dimming curve. On-off switch positions shall bypass dimmer module.

4. 600 W; dimmers shall require no derating when ganged with other devices.

5. As per construction documents.

D. Fluorescent Lamp Dimmer Switches: Modular; compatible with dimmer ballasts; trim potentiometer to adjust low-end dimming; dimmer-ballast combination capable of consistent dimming with low end not greater than 20 percent of full brightness.

2.10 OCCUPANCY SENSORS

A. Wall or Ceiling Sensors:

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

2. Products: Subject to compliance with requirements, provide one of the following:

a. Cooper

b. Hubbell

c. Leviton

d. Pass & Seymour

e. Watt Stopper (The)

f. Engineer approved equal.

2.11 WALL PLATES

A. Single and combination types to match corresponding wiring devices.

1. Plate-Securing Screws: Metal with head color to match plate finish.
2. Material for Finished Spaces: 0.035-inch thick, satin-finished stainless steel.
3. Material for Unfinished Spaces: Galvanized steel.
4. Material for Damp Locations: Cast aluminum with spring-loaded lift cover, and listed and labeled for use in "wet locations."

B. Wet-Location, Weatherproof While In Use Cover Plates: NEMA 250, complying with type 3R weather-resistant, die-cast aluminum with lockable cover.

2.12 FLOOR SERVICE FITTINGS

A. Type: Modular, flush-type, dual-service units suitable for wiring method used.

B. Compartments: Barrier separates power from voice and data communication cabling.

C. Service Plate: Rectangular, die-cast aluminum with satin finish.

D. Power Receptacle: NEMA WD 6 configuration 5-20R, gray finish, unless otherwise indicated.

2.13 FINISHES

A. Color: Wiring device catalog numbers in Section Text do not designate device color.

1. Wiring Devices Connected to Normal Power System: As selected by Architect, unless otherwise indicated or required by NFPA 70 or device listing.
2. TVSS Devices: Blue.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Comply with NECA 1, including the mounting heights listed in that standard, unless otherwise noted.

B. Coordination with Other Trades:

1. Take steps to insure that devices and their boxes are protected. 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 the 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 just 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 all devices that have been in temporary use during construction or that show signs that they 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, 2/3 to 3/4 of the way around terminal screw.
6. Use a torque screwdriver when a torque is recommended or required by the 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. Receptacle Orientation:

1. Install ground pin of vertically mounted receptacles up.

F. 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.

G. Dimmers:

1. Install dimmers within terms of their listing.
2. Verify that dimmers used for fan speed control are listed for that application.
3. Install unshared neutral conductors on line and load side of dimmers according to manufacturers' device listing conditions in the written instructions.

H. 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.

I. Adjust locations of floor service outlets and service poles to suit arrangement of partitions and furnishings.

3.02 IDENTIFICATION

A. Comply with Division 26 Section "Identification for Electrical Systems."

1. Receptacles: Identify panelboard and circuit number from which served. Use machine printing with black lettering on face of plate, and durable wire markers or tags inside outlet boxes.

END OF SECTION

SECTION 26 2816

ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.01 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.

1.02 SUMMARY

A. Section Includes:

1. Fusible switches.
2. Nonfusible switches.
3. Shunt trip switches.
4. Molded-case circuit breakers (MCCBs).
5. Molded-case switches.
6. Enclosures.

1.03 DEFINITIONS

A. NC: Normally closed.

B. NO: Normally open.

C. SPDT: Single pole, double throw.

1.04 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.
6. Include time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device.

B. Shop Drawings: For enclosed switches and circuit breakers. Include plans, elevations, sections, details, and attachments to other work.

1. Wiring Diagrams: For power, signal, and control wiring.

C. Operation and Maintenance Data: For enclosed switches and circuit breakers to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:

2. Manufacturer's written instructions for testing and adjusting enclosed switches and circuit breakers.
3. Time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device.

1.05 QUALITY ASSURANCE

A. Source Limitations: Obtain enclosed switches and circuit breakers, overcurrent protective devices, components, and accessories, within same product category, from single source from single manufacturer.

B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for enclosed switches and circuit breakers, including clearances between enclosures, and adjacent surfaces and other items. Comply with indicated maximum dimensions.

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 NFPA 70.

1.06 PROJECT CONDITIONS

A. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:

1. Ambient Temperature: Not less than minus 22 deg F (minus 30 deg C) and not exceeding 104 deg F (40 deg C).
2. Altitude: Not exceeding 6600 feet (2010 m).

B. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:

1. Notify Architect or Owner no fewer than seven days in advance of proposed interruption of electric service.
2. Indicate method of providing temporary electric service.
3. Do not proceed with interruption of electric service without Architect's or Owner's written permission.
4. Comply with NFPA 70E.

1.07 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.

1.08 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.
2. Fuse Pullers: Two for each size and type.

PART 2 - PRODUCTS

2.01 FUSIBLE SWITCHES

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 Inc.; Cutler-Hammer Business Unit.
2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
3. Siemens Energy & Automation, Inc.
4. Square D; a brand of Schneider Electric.
5. Engineer approved equal.

B. Type HD, Heavy Duty, Single Throw, 240-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate specified fuses, lockable handle with capability to accept three 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. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
3. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.
4. Lugs: Mechanical type, suitable for number, size, and conductor material.
5. Service-Rated Switches: Labeled for use as service equipment.

2.02 NONFUSIBLE SWITCHES

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 Inc.; Cutler-Hammer Business Unit.
2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
3. Siemens Energy & Automation, Inc.
4. Square D; a brand of Schneider Electric.
5. Engineer approved equal.

B. Type HD, Heavy Duty, Single Throw, 240-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three 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. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
3. Lugs: Mechanical type, suitable for number, size, and conductor material.

2.03 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. Outdoor Locations: NEMA 250, Type 3R.
2. Indoor, Dry and Clean Locations: NEMA 250, Type 1.
3. Kitchen Areas: NEMA 250, Type 3R,.

PART 3 - EXECUTION

3.01 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.

3.02 INSTALLATION

A. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.

B. Comply with mounting and anchoring requirements specified in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."

C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

D. Install fuses in fusible devices.

E. Comply with NECA 1.

3.03 IDENTIFICATION

A. Comply with requirements in Division 26 Section "Identification for Electrical Systems."

1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.

2. Label each enclosure with engraved metal or laminated-plastic nameplate.

3.04 ADJUSTING

A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.

END OF SECTION

SECTION 26 4313
TRANSIENT-VOLTAGE SUPPRESSION FOR LOW-VOLTAGE ELECTRICAL POWER CIRCUITS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section includes field-mounted TVSS for low-voltage (120 to 600 V) power distribution and control equipment.

B. Related Sections:

1. Division 26 Section "Switchboards" for factory-installed TVSS.
2. Division 26 Section "Panelboards" for factory-installed TVSS.
3. Division 26 Section "Wiring Devices" for devices with integral TVSS.

1.03 DEFINITIONS

A. ATS: Acceptance Testing Specifications.

B. SVR: Suppressed voltage rating.

C. TVSS: Transient voltage surge suppressor(s), both singular and plural; also, transient voltage surge suppression.

1.04 SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities, operating weights, electrical characteristics, furnished specialties, and accessories.

B. Operation and Maintenance Data: For TVSS devices to include in emergency, operation, and maintenance manuals.

C. Warranties: Sample of special warranties.

1.05 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a testing agency, and marked for intended location and application.

B. Comply with IEEE C62.41.2 and test devices according to IEEE C62.45.

C. Comply with NEMA LS 1.

D. Comply with UL 1283 and UL 1449.

E. Comply with NFPA 70.

1.06 PROJECT CONDITIONS

A. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electrical service according to requirements indicated:

1. Notify Architect or Owner no fewer than three days in advance of proposed electrical service interruptions.
2. Do not proceed with interruption of electrical service without Architect's or Owner's written permission.

B. Service Conditions: Rate TVSS devices for continuous operation under the following conditions unless otherwise indicated:

1. Maximum Continuous Operating Voltage: Not less than 115 percent of nominal system operating voltage.
2. Operating Temperature: 30 to 120 deg F.
3. Humidity: 0 to 85 percent, non-condensing.

4. Altitude: Less than 20,000 feet above sea level.

1.07 COORDINATION

A. Coordinate location of field-mounted TVSS devices to allow adequate clearances for maintenance.

B. Coordinate TVSS devices with Division 26 Section "Electrical Power Monitoring and Control."

1.08 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of surge suppressors that fails in materials or workmanship within specified warranty period.

1. Warranty Period: One year from date of Substantial Completion.

B. Special Warranty for Cord-Connected, Plug-in Surge Suppressors: Manufacturer's standard form in which manufacturer agrees to repair or replace electronic equipment connected to circuits protected by surge suppressors.

1.09 SERVICE ENTRANCE SUPPRESSORS

A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

1. ABB USA.
2. AC Data Solutions.
3. Advanced Protection Technologies Inc. (APT).
4. Atlantic Scientific.
5. Current Technology Inc.; Danaher Power Solutions.
6. Danaher Power Solutions; United Power Products.
7. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
8. Intermatic, Inc.
9. LEA International.
10. Leviton Mfg. Company Inc.
11. Liebert Corporation; a division of Emerson Network Power.
12. Northern Technologies, Inc.; a division of Emerson Network Power.
13. Siemens Energy & Automation, Inc.
14. Square D; a brand of Schneider Electric.
15. Surge Suppression Incorporated.
16. Engineer approved equal.

B. Surge Protection Devices:

1. Non-modular.
2. LED indicator lights for power and protection status.
3. Audible alarm, with silencing switch, to indicate when protection has failed.
4. Form-C contacts rated at 5 A and 250-V ac, one normally open and one normally closed, for remote monitoring of protection status. Contacts shall reverse on failure of any surge diversion module or on opening of any current-limiting device. Coordinate with building power monitoring and control system.

C. Surge Protection Devices:

1. Comply with UL 1449.
2. Modular design (with field-replaceable modules).
3. Fuses, rated at 200-kA interrupting capacity.
4. Fabrication using bolted compression lugs for internal wiring.
5. Integral disconnect switch.

6. Redundant suppression circuits.
7. Redundant replaceable modules.
8. Arrangement with copper bus bars and for bolted connections to phase buses, neutral bus, and ground bus.
9. Arrangement with wire connections to phase buses, neutral bus, and ground bus.
10. LED indicator lights for power and protection status.
11. Audible alarm, with silencing switch, to indicate when protection has failed.
12. Form-C contacts rated at 5 A and 250-V ac, one normally open and one normally closed, for remote monitoring of protection status. Contacts shall reverse on failure of any surge diversion module or on opening of any current-limiting device. Coordinate with building power monitoring and control system.
13. Four-digit transient-event counter set to totalize transient surges.

D. Peak Single-Impulse Surge Current Rating: 160 kA per mode/320 kA per phase.

E. Minimum single impulse current ratings, using 8-by-20-mic.sec waveform described in IEEE C62.41.2
1. Line to Neutral: 70,000 A.
2. Line to Ground: 70,000 A.
3. Neutral to Ground: 50,000 A.

F. Protection modes and UL 1449 SVR for grounded wye circuits with 208Y/120 V, 3-phase, 4-wire circuits shall be as follows:
1. Line to Neutral: 400 V for 208Y/120 V.
2. Line to Ground: 400 V for 208Y/120 V.
3. Neutral to Ground: 400 V for 208Y/120 V.

1.10 PANELBOARD SUPPRESSORS

A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
1. ABB USA.
2. AC Data Solutions.
3. Advanced Protection Technologies Inc. (APT).
4. Atlantic Scientific.
5. Current Technology Inc.; Danaher Power Solutions.
6. Danaher Power Solutions; United Power Products.
7. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
8. Intermatic, Inc.
9. LEA International.
10. Leviton Mfg. Company Inc.
11. Liebert Corporation; a division of Emerson Network Power.
12. Northern Technologies, Inc.; a division of Emerson Network Power.
13. Siemens Energy & Automation, Inc.
14. Square D; a brand of Schneider Electric.
15. Surge Suppression Incorporated.
16. Engineer approved equal.

B. Surge Protection Devices:
1. Non-modular.
2. LED indicator lights for power and protection status.

3. Audible alarm, with silencing switch, to indicate when protection has failed.
4. Form-C contacts rated at 5 A and 250-V ac, one normally open and one normally closed, for remote monitoring of protection status. Contacts shall reverse on failure of any surge diversion module or on opening of any current-limiting device. Coordinate with building power monitoring and control system.

C. Surge Protection Devices:
1. Comply with UL 1449.
2. Modular design (with field-replaceable modules).
3. Short-circuit current rating complying with UL 1449, and matching or exceeding the panelboard short-circuit rating and redundant suppression circuits; with individually fused metal-oxide varistors.
4. Fuses, rated at 200-kA interrupting capacity.
5. Fabrication using bolted compression lugs for internal wiring.
6. Integral disconnect switch.
7. Redundant suppression circuits.
8. Redundant replaceable modules.
9 Arrangement with wire connections to phase buses, neutral bus, and ground bus.
10. LED indicator lights for power and protection status.
11. Audible alarm, with silencing switch, to indicate when protection has failed.
12. Form-C contacts rated at 5 A and 250-V ac, one normally open and one normally closed, for remote monitoring of protection status. Contacts shall reverse on failure of any surge diversion module or on opening of any current-limiting device. Coordinate with building power monitoring and control system.
13. Four-digit transient-event counter set to totalize transient surges.

D. Peak Single-Impulse Surge Current Rating: 160 kA per mode/320 kA per phase.

E. Minimum single impulse current ratings, using 8-by-20-mic.sec waveform described in IEEE C62.41.2:
1. Line to Neutral: 70,000 A.
2. Line to Ground: 70,000 A.
3. Neutral to Ground: 50,000 A.

F. Protection modes and UL 1449 SVR for grounded wye circuits with 208Y/120 V, 3-phase, 4-wire circuits shall be as follows:
1. Line to Neutral: 400 V for 208Y/120 V.
2. Line to Ground: 400 V for 208Y/120 V.
3. Neutral to Ground: 400 V for 208Y/120 V.

1.11 ENCLOSURES

A. Indoor Enclosures: NEMA 250 Type 1.

B. Outdoor Enclosures: NEMA 250 Type 3R.

PART 2 - EXECUTION

2.01 INSTALLATION

A. Install TVSS devices at service entrance on load side, with ground lead bonded to service entrance ground.

B. Install TVSS devices for panelboards and auxiliary panels with conductors or buses between suppressor and points of attachment as short and straight as possible. Do not exceed manufacturer's recommended lead length. Do not bond neutral and ground.
1. Provide multiple, 30-A circuit breaker as a dedicated disconnecting means for TVSS unless otherwise indicated.

2.02 STARTUP SERVICE

A. Do not energize or connect service entrance equipment and panelboards to their sources until TVSS devices are installed and connected.

B. Do not perform insulation resistance tests of the distribution wiring equipment with the TVSS installed. Disconnect before conducting insulation resistance tests, and reconnect immediately after the testing is over.

2.03 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to maintain TVSS devices.

END OF SECTION

SECTION 26 5100

INTERIOR LIGHTING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. This Section includes the following:

1. Interior lighting fixtures, lamps, and ballasts.
2. Emergency lighting units.
3. Exit signs.
4. Lighting fixture supports.

1.03 DEFINITIONS

A. CRI: Color-rendering index.

B. CU: Coefficient of utilization.

C. LER: Luminaire efficacy rating.

D. Luminaire: Complete lighting fixture, including ballast housing if provided.

E. RCR: Room cavity ratio.

1.04 SUBMITTALS

A. Product Data: For each type of lighting fixture, arranged in order of fixture designation. Include data on features, accessories, finishes, and the following:

1. Physical description of lighting fixture including dimensions.
2. Emergency lighting units including battery and charger.
3. LED Drivers.
4. Energy-efficiency data.
5. Life, output, and energy-efficiency data for lamps and drivers.
6. Photometric data, in IESNA format, based on laboratory tests of each lighting fixture type, outfitted with lamps, ballasts, and accessories identical to those indicated for the lighting fixture as applied in this Project.
    a. For indicated fixtures, photometric data shall be certified by a qualified independent testing agency. Photometric data for remaining fixtures shall be certified by the manufacturer.
    b. Photometric data shall be certified by a manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program (NVLAP) for Energy Efficient Lighting Products.

B. Shop Drawings: Show details of nonstandard or custom lighting fixtures. Indicate dimensions, weights, methods of field assembly, components, features, and accessories.

1. Wiring Diagrams: Power and control wiring.

C. Operation and Maintenance Data: For lighting equipment and fixtures to include in emergency, operation, and maintenance manuals.

1.05 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with NFPA 70.

1.06 COORDINATION

A. Coordinate layout and installation of lighting fixtures and suspension system with other construction that penetrates ceilings or is supported by them, including HVAC equipment, fire-suppression system, and partition assemblies.

1.07 WARRANTY

A. Special Warranty for Emergency Lighting Batteries: Manufacturer's standard form in which manufacturer of battery-powered emergency lighting unit agrees to repair or replace components of rechargeable batteries that fail in materials or workmanship within specified warranty period.

1. Warranty Period for Emergency Lighting Unit Batteries: One years from date of Substantial Completion. Full warranty shall apply for first year, and prorated warranty for the remaining nine years.

2. Warranty Period for Emergency LED and Self-Powered Exit Sign Batteries: One years from date of Substantial Completion. Full warranty shall apply for first year, and prorated warranty for the remaining six years.

B. Special Warranty for LED Drivers: Manufacturer's standard form in which driver manufacturer agrees to repair or replace drivers that fail in materials or workmanship within specified warranty period.

1. Warranty Period for LED Drivers: One year from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

B. In Interior Lighting Fixture Schedule where titles below are column or row headings that introduce lists, the following requirements apply to product selection:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.

2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

3. Basis-of-Design Product: The design for each lighting fixture is based on the product named. Subject to compliance with requirements, provide either the named product or a comparable product by one of the other manufacturers specified.

2.02 LIGHTING FIXTURES AND COMPONENTS, GENERAL REQUIREMENTS

A. Recessed Fixtures: Comply with NEMA LE 4 for ceiling compatibility for recessed fixtures.

B. Metal Parts: Free of burrs and sharp corners and edges.

C. Sheet Metal Components: Steel, unless otherwise indicated. Form and support to prevent warping and sagging.

D. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.

E. Reflecting surfaces shall have minimum reflectance as follows, unless otherwise indicated:

1. White Surfaces: 85 percent.

2. Specular Surfaces: 83 percent.

3. Diffusing Specular Surfaces: 75 percent.

4. Laminated Silver Metallized Film: 90 percent.

F. Plastic Diffusers, Covers, and Globes:

1. Acrylic Lighting Diffusers: 100 percent virgin acrylic plastic. High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
    a. Lens Thickness: At least 0.125 inch (3.175 mm) minimum unless different thickness is indicated.
    b. UV stabilized.

2.03 EMERGENCY LED POWER UNIT

A. Internal Type: Self-contained, modular, battery-inverter unit, factory mounted within lighting fixture body and compatible with driver. Comply with UL 924.
    1. Emergency Connection: Operate all lamps continuously at rated output of fixture. Connect unswitched circuit to battery-inverter unit and switched circuit to fixture ballast.
    2. Test Push Button and Indicator Light: Visible and accessible without opening fixture or entering ceiling space.
        a. Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
        b. Indicator Light: LED indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.
    3. Battery: Sealed, maintenance-free, nickel-cadmium type.
    4. Charger: Fully automatic, solid-state, constant-current type with sealed power transfer relay.
    5. Remote Test: Switch in hand-held remote device aimed in direction of tested unit initiates coded infrared signal. Signal reception by factory-installed infrared receiver in tested unit triggers simulation of loss of its normal power supply, providing visual confirmation of either proper or failed emergency response.
    6. Integral Self-Test: Factory-installed electronic device automatically initiates code-required test of unit emergency operation at required intervals. Test failure is annunciated by an integral audible alarm and flashing red LED.

2.04 EXIT SIGNS

A. Description: Comply with UL 924; for sign colors, visibility, luminance, and lettering size, comply with authorities having jurisdiction.

B. Internally Lighted Signs:
    1. Lamps for AC Operation: LEDs, 70,000 hours minimum rated lamp life.
    2. Self-Powered Exit Signs (Battery Type): Integral automatic charger in a self-contained power pack.
        a. Battery: Sealed, maintenance-free, nickel-cadmium type.
        b. Charger: Fully automatic, solid-state type with sealed transfer relay.
        c. Operation: Relay automatically energizes lamp from battery when circuit voltage drops to 80 percent of nominal voltage or below. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.
        d. Test Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
        e. LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.
        f. Remote Test: Switch in hand-held remote device aimed in direction of tested unit initiates coded infrared signal. Signal reception by factory-installed infrared receiver in tested unit triggers simulation of loss of its normal power supply, providing visual confirmation of either proper or failed emergency response.
        g. Integral Self-Test: Factory-installed electronic device automatically initiates code-required test of unit emergency operation at required intervals. Test failure is annunciated by an integral audible alarm and flashing red LED.

2.05 EMERGENCY LIGHTING UNITS

A. Description: Self-contained LED units complying with UL 924.

1. Battery: Sealed, maintenance-free, Nickel cadmium type.
2. Charger: Fully automatic, solid-state type with sealed transfer relay.
3. Operation: Relay automatically turns lamp on when power supply circuit voltage drops to 80 percent of nominal voltage or below. Lamp automatically disconnects from battery when voltage approaches deep-discharge level. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.
4. Test Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
5. LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.
6. Wire Guard: Heavy-chrome-plated wire guard protects lamp heads or fixtures.
7. Integral Time-Delay Relay: Holds unit on for fixed interval of 15 minutes when power is restored after an outage.
8. Remote Test: Switch in hand-held remote device aimed in direction of tested unit initiates coded infrared signal. Signal reception by factory-installed infrared receiver in tested unit triggers simulation of loss of its normal power supply, providing visual confirmation of either proper or failed emergency response.
9. Integral Self-Test: Factory-installed electronic device automatically initiates code-required test of unit emergency operation at required intervals. Test failure is annunciated by an integral audible alarm and flashing red LED.

2.06 LIGHTING FIXTURE SUPPORT COMPONENTS

A. Comply with Division 26 Section "Hangers and Supports for Electrical Systems" for channel- and angle-iron supports and nonmetallic channel and angle supports.

B. Single-Stem Hangers: 1/2-inch steel tubing with swivel ball fittings and ceiling canopy. Finish same as fixture.

C. Twin-Stem Hangers: Two, 1/2-inch steel tubes with single canopy designed to mount a single fixture. Finish same as fixture.

D. Wires: ASTM A 641/A 641M, Class 3, soft temper, zinc-coated steel, 12 gauge.

E. Wires for Humid Spaces: ASTM A 580/A 580M, Composition 302 or 304, annealed stainless steel, 12 gauge.

F. Rod Hangers: 3/16-inch minimum diameter, cadmium-plated, threaded steel rod.

G. Hook Hangers: Integrated assembly matched to fixture and line voltage and equipped with threaded attachment, cord, and locking-type plug.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Lighting fixtures: Set level, plumb, and square with ceilings and walls.

B. Support for Lighting Fixtures in or on Grid-Type Suspended Ceilings: Use grid as a support element.

1. Install a minimum of four ceiling support system rods or wires for each fixture. Locate not more than 6 inches from lighting fixture corners.
2. Support Clips: Fasten to lighting fixtures and to ceiling grid members at or near each fixture corner with clips that are UL listed for the application.
3. Fixtures of Sizes Less Than Ceiling Grid: Install as indicated on reflected ceiling plans or center in acoustical panel, and support fixtures independently with at least two 3/4-inch metal channels spanning and secured to ceiling tees.

4. Install 4 independent support rod or wire from structure to a tab on lighting fixture. Wire or rod shall have breaking strength of the weight of fixture at a safety factor of 3.

C. Suspended Lighting Fixture Support:

1. Pendants and Rods: Where longer than 48 inches brace to limit swinging.
2. Stem-Mounted, Single-Unit Fixtures: Suspend with twin-stem hangers.
3. Continuous Rows: Use tubing or stem for wiring at one point and tubing or rod for suspension for each unit length of fixture chassis, including one at each end.
4. Fixtures are to be secured to structure and not lay-in ceiling system grids.

D. Adjust aimable lighting fixtures to provide required light intensities.

E. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.02 FIELD QUALITY CONTROL

A. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery and retransfer to normal.

B. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.

END OF SECTION

SECTION 26 5600

EXTERIOR LIGHTING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. This Section includes the following:

1. Exterior luminaires with lamps and drivers.
2. Poles and accessories.

1.03 DEFINITIONS

A. CRI: Color-rendering index.

B. LED: Light Emitting Diodes.

C. Luminaire: Complete lighting fixture, including LED driver housing if provided.

D. Pole: Luminaire support structure, including tower used for large area illumination.

E. Standard: Same definition as "Pole" above.

1.04 SUBMITTALS

A. Product Data: For each luminaire, pole, and support component, arranged in order of lighting unit designation. Include data on features, accessories, finishes, and the following:

1. Physical description of luminaire, including materials, dimensions, effective projected area, and verification of indicated parameters.
2. Details of attaching luminaires and accessories.
3. Details of installation and construction.
4. Luminaire materials.
5. Photometric data based on laboratory tests of each luminaire type, complete with indicated LED Lamps/Modules, drivers, and accessories.
    a. For indicated luminaires, photometric data shall be certified by a qualified independent testing agency. Photometric data for remaining luminaires shall be certified by manufacturer.
    b. Photometric data shall be certified by manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products.
6. LED Driver, including energy-efficiency data.
7. LED Lamps/Modules, including life, output, and energy-efficiency data.
8. Materials, dimensions, and finishes of poles.
9. Means of attaching luminaires to supports, and indication that attachment is suitable for components involved.
10. Anchor bolts for poles.

B. Shop Drawings:

1. Anchor-bolt templates keyed to specific poles and certified by manufacturer.
2. Design calculations, certified by a qualified professional engineer, indicating strength of screw foundations and soil conditions on which they are based.
3. Wiring Diagrams: Power and control wiring.

C. Operation and Maintenance Data: For luminaires and poles to include in emergency, operation, and maintenance manuals.

D. Warranty: Special warranty specified in this Section.

1.05 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use, i.e. U.L. Listing, CSA Listing.

B. Comply with IEEE C2, "National Electrical Safety Code."

C. Comply with NFPA 70.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Package aluminum poles for shipping according to ASTM B 660.

B. Store poles on decay-resistant-treated skids at least 12 inches (300 mm) above grade and vegetation. Support poles to prevent distortion and arrange to provide free air circulation.

C. Retain factory-applied pole wrappings on metal poles until right before pole installation. For poles with nonmetallic finishes, handle with web fabric straps.

1.07 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace products that fail in materials or workmanship; that corrode; or that fade, stain, perforate, erode, or chalk due to effects of weather or solar radiation within specified warranty period. Manufacturer may exclude lightning damage, hail damage, vandalism, abuse, or unauthorized repairs or alterations from special warranty coverage.

1. Warranty Period for Luminaires: One year from date of Substantial Completion.
2. Warranty Period for Metal Corrosion: One year from date of Substantial Completion.
3. Warranty Period for Color Retention: One year from date of Substantial Completion.
4. Warranty Period for LED Lamps/Modules: Replace LED lamps/modules and fuses that fail within 12 months from date of Substantial Completion; furnish replacement LED lamps/modules and fuses that fail within the second 12 months from date of Substantial Completion.
5. Warranty Period for Poles: Repair or replace lighting poles and standards that fail in finish, materials, and workmanship within manufacturer's standard warranty period, but not less than One year from date of Substantial Completion.
6. Warranty period for LED drivers: One year from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

B. In Exterior Lighting Device Schedule where titles below are column or row headings that introduce lists, the following requirements apply to product selection:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, manufacturers specified.
2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.
3. Basis of Design Product: The design of each item of exterior luminaire and its support is based on the product named.

2.02 LUMINAIRES, GENERAL REQUIREMENTS

A. Luminaires shall comply with UL 1598 and be listed and labeled for installation in wet locations by an NRTL acceptable to authorities having jurisdiction.

B. Comply with IESNA RP-8 for parameters of lateral light distribution patterns indicated for luminaires.

C. Metal Parts: Free of burrs and sharp corners and edges.

D. Sheet Metal Components: Corrosion-resistant aluminum, unless otherwise indicated. Form and support to prevent warping and sagging.

E. Housings: Rigidly formed, weather- and light-tight enclosures that will not warp, sag, or deform in use. Provide filter/breather for enclosed luminaires.

F. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position. Doors shall be removable for cleaning or replacing lenses. Designed to disconnect ballast when door opens.

G. Exposed Hardware Material: Stainless steel.

H. Plastic Parts: High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.

I. Light Shields: Metal baffles, factory installed and field adjustable, arranged to block light distribution to indicated portion of normally illuminated area or field.

J. Reflecting surfaces shall have minimum reflectance as follows, unless otherwise indicated:

1. White Surfaces: 85 percent.
2. Specular Surfaces: 83 percent.
3. Diffusing Specular Surfaces: 75 percent.

K. Lenses and Refractors Gaskets: Use heat- and aging-resistant resilient gaskets to seal and cushion lenses and refractors in luminaire doors.

L. Luminaire Finish: Manufacturer's standard paint applied to factory-assembled and -tested luminaire before shipping. Where indicated, match finish process and color of pole or support materials.

M. Factory-Applied Finish for Steel Luminaires: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

1. Surface Preparation: Clean surfaces to comply with SSPC-SP 1, "Solvent Cleaning," to remove dirt, oil, grease, and other contaminants that could impair paint bond. Grind welds and polish surfaces to a smooth, even finish. Remove mill scale and rust, if present, from uncoated steel, complying with SSPC-SP 5/NACE No. 1, "White Metal Blast Cleaning," or SSPC-SP 8, "Pickling."
2. Exterior Surfaces: Manufacturer's standard finish consisting of one or more coats of primer and two finish coats of high-gloss, high-build polyurethane enamel.
    a. Color: As selected from manufacturer's standard catalog of colors unless otherwise indicated.

N. Factory-Applied Finish for Aluminum Luminaires: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

1. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
2. Natural Satin Finish: Provide fine, directional, medium satin polish (AA-M32); buff complying with AA-M20; and seal aluminum surfaces with clear, hard-coat wax.
3. Class I, Clear Anodic Finish: AA-M32C22A41 (Mechanical Finish: medium satin; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, clear coating 0.018 mm or thicker) complying with AAMA 611.
4. Class I, Color Anodic Finish: AA-M32C22A42/A44 (Mechanical Finish: medium satin; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, integrally colored or electrolytically deposited color coating 0.018 mm or thicker) complying with AAMA 611.
    a. Color: as indicated.

2.03 STEEL POLES

A. Poles: Comply with ASTM A 500, Grade B, carbon steel with a minimum yield of 46,000 psig (317 MPa); 1-piece construction up to 40 feet in height with access handhole in pole wall.

1. Shape: Round, straight or Square, straight as indicated on construction documents.

2. Mounting Provisions: Butt flange for bolted mounting on foundation or breakaway support.

3. All poles to have hinged base.

B. Steel Mast Arms: as indicated on construction documents. Material and finish same as pole.

C. Brackets for Luminaires: Detachable, cantilever, without underbrace.

1. Adapter fitting welded to pole and bracket, then bolted together with galvanized-steel bolts.

2. Cross Section: Tapered oval, with straight tubular end section to accommodate luminaire.

3. Match pole material and finish.

D. Pole-Top Tenons: Fabricated to support luminaire or luminaires and brackets indicated, and securely fastened to pole top.

E. Steps: Fixed steel, with nonslip treads, positioned for 15-inch vertical spacing, alternating on opposite sides of pole; first step at elevation 10 feet above finished grade.

F. Intermediate Handhole and Cable Support: Weathertight, 3-by-5-inch handhole located at midpoint of pole with cover for access to internal welded attachment lug for electric cable support grip.

G. Grounding and Bonding Lugs: Welded 1/2-inch threaded lug, complying with requirements in Division 26 Section "Grounding and Bonding for Electrical Systems," listed for attaching grounding and bonding conductors of type and size listed in that Section, and accessible through handhole.

H. Cable Support Grip: Wire-mesh type with rotating attachment eye, sized for diameter of cable and rated for a minimum load equal to weight of supported cable times a 5.0 safety factor.

I. Galvanized Finish: After fabrication, hot-dip galvanize complying with ASTM A 123/A 123M.

J. Factory-Painted Finish: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

1. Surface Preparation: Clean surfaces to comply with SSPC-SP 1, "Solvent Cleaning," to remove dirt, oil, grease, and other contaminants that could impair paint bond. Grind welds and polish surfaces to a smooth, even finish. Remove mill scale and rust, if present, from uncoated steel, complying with SSPC-SP 5/NACE No. 1, "White Metal Blast Cleaning," or SSPC-SP 8, "Pickling."

2. Interior Surfaces of Pole: One coat of bituminous paint, or otherwise treat for equal corrosion protection.

3. Exterior Surfaces: Manufacturer's standard finish consisting of one or more coats of primer and two finish coats of high-gloss, high-build polyurethane enamel.

a. Color: As selected by Architect from manufacturer's full range.

2.04 ALUMINUM POLES

A. Poles: Seamless, extruded structural tube complying with ASTM B 429, Alloy 6063-T6 with access handhole in pole wall.

B. Poles: ASTM B 209 (ASTM B 209M), 5052-H34 marine sheet alloy with access handhole in pole wall.

1. Shape: Round, straight or Square, straight as indicated on the construction documents.

2. Mounting Provisions: Butt flange for bolted mounting on foundation or breakaway support.

3. All poles to have hinged base.

C. Pole-Top Tenons: Fabricated to support luminaire or luminaires and brackets indicated, and securely fastened to pole top.

D. Grounding and Bonding Lugs: Welded 1/2-inch threaded lug, complying with requirements in Division 26 Section "Grounding and Bonding for Electrical Systems," listed for attaching

grounding and bonding conductors of type and size listed in that Section, and accessible through handhole.

E. Aluminum Finish: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

1. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.

2. Natural Satin Finish: Provide fine, directional, medium satin polish (AA-M32); buff complying with AA-M20; and seal aluminum surfaces with clear, hard-coat wax.

3. Class I, Clear Anodic Finish: AA-M32C22A41 (Mechanical Finish: medium satin; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, clear coating 0.018 mm or thicker) complying with AAMA 611.

4. Class I, Color Anodic Finish: AA-M32C22A42/A44 (Mechanical Finish: medium satin; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, integrally colored or electrolytically deposited color coating 0.018 mm or thicker) complying with AAMA 611.

a. Color: As selected by Architect from manufacturer's full range.

2.05 POLE ACCESSORIES

A. Base Covers: Manufacturers' standard metal units, arranged to cover pole's mounting bolts and nuts. Finish same as pole.

PART 3 - EXECUTION

3.01 LUMINAIRE INSTALLATION

A. Install LED lamps/modules in each luminaire as required.

B. Fasten luminaire to indicated structural supports.

1. Use fastening methods and materials selected to resist seismic forces defined for the application and approved by manufacturer.

C. Adjust luminaires that require field adjustment or aiming.

D. All in-grade luminaires to be set in concrete base flush with grade, sized per manufacturer’s recommendations.

E. All above grade mounted directional fixtures to be supported on approved weatherproof j-box secured in concrete base. No spike mounting systems will be used.

F. All luminaires mounted to above grade architectural or structural elements to be securely fastened and supported to minimize sagging and movement from weather or vandalism. Coordinate exact mounting locations with Architect/Engineer prior to installation.

3.02 POLE INSTALLATION

A. Align pole foundations and poles for optimum directional alignment of luminaires and their mounting provisions on the pole.

B. Clearances: Maintain the following minimum horizontal distances of poles from surface and underground features, unless otherwise indicated on Drawings:

1. Fire Hydrants and Storm Drainage Piping: 60 inches.

2. Water, Gas, Electric, Communication, and Sewer Lines: 10 feet.

3. Trees: 15 feet.

C. Concrete Pole Foundations: Set anchor bolts according to anchor-bolt templates furnished by pole manufacturer. Concrete materials, installation, and finishing requirements are specified in Division 03 Section "Cast-in-Place Concrete."

D. Foundation-Mounted Poles: Mount pole with leveling nuts, and tighten top nuts to torque level recommended by pole manufacturer.

1. Use anchor bolts and nuts selected to resist seismic forces defined for the application and approved by manufacturer.

2. Grout void between pole base and foundation. Use non-shrink or expanding concrete grout firmly packed to fill space.

3. Install base covers, unless otherwise indicated.

4. Use a short piece of 1/2-inch- diameter pipe to make a drain hole through grout. Arrange to drain condensation from interior of pole.

E. Raise and set poles using web fabric slings (not chain or cable).

3.03 CORROSION PREVENTION

A. Aluminum: Do not use in contact with earth or concrete. When in direct contact with a dissimilar metal, protect aluminum by insulating fittings or treatment.

B. Steel Conduits: Comply with Division 26 Section "Raceway and Boxes for Electrical Systems." In concrete foundations, wrap conduit with 0.010-inch- thick, pipe-wrapping plastic tape applied with a 50 percent overlap.

3.04 GROUNDING

A. Ground metal poles and support structures according to Division 26 Section "Grounding and Bonding for Electrical Systems."

1. Install grounding electrode for each pole, unless otherwise indicated.

2. Install grounding conductor pigtail in the base for connecting luminaire to grounding system.

B. Ground nonmetallic poles and support structures according to Division 26 Section "Grounding and Bonding for Electrical Systems."

3. Install grounding conductor and conductor protector.

4. Ground metallic components of pole accessories and foundations.

3.05 FIELD QUALITY CONTROL

A. Inspect each installed fixture for damage. Replace damaged fixtures and components.

B. Illumination Observations: Verify normal operation of lighting units after installing luminaires and energizing circuits with normal power source.

END OF SECTION

SECTION 27 00 00

TELECOMMUNICATIONS CABLING SYSTEM

PART 1 – GENERAL

1.01 RELATED DOCUMENTS:

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

B. Division-16 or 26, Basic Materials and Methods sections apply to work specified in this section.

1.02 REFERENCE STANDARDS

A. ANSI/TIA-492.AAAC-B – Detail Specification for 850-nm Laser-Optimized, 50-um Core Diameter/125-um Cladding Diameter Class 1a Graded-Index Multimode Optical Fibers

B. ANSI/TIA-492.AAAD – Detail Specification for 850-nm Laser- Optimized, 50-µm Core Diameter/125-µm Cladding Diameter Class Ia Graded-Index Multimode Optical Fibers Suitable for Manufacturing OM4 Cabled Optical Fiber

C. ANSI/TIA-492.CAAB – Detail Specification for Class IVa Dispersion-Unshifted Single-Mode Optical Fibers with Low Water Peak. Current Edition

D. ANSI/TIA-568.0-D – Generic Communications Cabling for Customer Premises

E. ANSI/TIA-568.1-D – Commercial Building Communications Cabling Standard

F. ANSI/TIA-568-C.2-1 – Balanced Twisted-Pair Telecommunications Cabling and Components Standards

G. ANSI/TIA-568.3-D – Optical Fiber Cabling and Components Standard

H. ANSI/TIA-569-D – Telecommunications Pathways and Spaces

I. ANSI/TIA-606-B.1 – Administration Standard for the Commercial Telecommunications Infrastructure.

J. ANSI/TIA-607-C – Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises

K. ANSI/TIA-862-B – Structured Cabling Infrastructure Standard for Intelligent Building Systems

L. ANSI/TIA-942-A – Telecommunications Infrastructure Standard for Data Centers

M. NFPA 70 – National Electrical Code (NEC).

N. BICSI – TDMM, Building Industries Consulting Services International, Telecommunications Distribution Methods Manual (TDMM)

1.03 GOVERNANCE

A. The Electrical Code referred to in these specifications is the National Electrical Code as currently adopted by the State of California. All work will be provided in strict compliance with the Electrical Code and all regulations that may apply.

B. Where standards exist, for a particular category, products used on this project will be listed by an OSHA approved Nationally Recognized Testing Laboratory (NRTL), and be approved or listed for the intended service and application.

C. These specifications do not undertake to repeat the requirements of codes, regulations or NRTL listing or labeling instructions. The Specifications or Drawings may require items or work beyond the requirements of applicable codes or regulations. The stricter, higher quality, greater quantity or higher cost will be allowed, and accommodations must be approved by Owner prior to procurement or installation. It is incumbent on the Installer, material and equipment suppliers to meet these specifications, applicable codes, regulations, and NRTL listing agency restrictions.

D. The word "Manufacturer" will include the Manufacturer, the Manufacturer's Representative, the Distributor, the Fabricator, and the Supplier of the particular classification of equipment, system, product, and material.

E. All work, equipment, and systems will be manufactured, provided, repaired, installed, and tested in accordance with the latest edition and all current amendments of the applicable publications and standards of the organizations listed below as of the date of the Contract Documents. When the Specification requirements exceed the requirements of these publications and standards the Specifications will govern:

1. State Building Code (SBC)
2. Building Department Inspectional Services
3. American Society for Testing and Materials (ASTM)
4. Underwriter's Laboratories, Inc. (UL)
5. Insulated Cable Engineers Association (ICEA)
6. National Electrical Manufacturers Association (NEMA)
7. Institute of Electrical and Electronics Engineers, Inc. (IEEE)
8. American National Standards Institute, Inc. (ANSI)
9. National Fire Protection Association (NFPA)
10. Local Electric Code
11. Department of Public Safety (DPS)
12. Building Officials and Code Administrators International, Inc. (BOCA)
13. Department of Labor USA. Safety and Health Regulations for Construction (OSHA)
14. Energy Codes
15. National Electrical Contractors Association (NECA)
16. National Bureau of Standards (NBS)
17. Federal Communications Commission (FCC)
18. Utilities Serving Project.
19. Fire Department.
20. Americans with Disabilities Act Applications Guidelines (ADAAG).
21. Accessibility Guidelines for Buildings and Facilities.
22. Any and all Federal, State and Local Standards, Codes and Authorities having Jurisdiction.

F. In addition, all phases of the Structured Cabling System installation will adhere to applicable

Local Area Network (LAN) Specifications of the IEEE, Electronics Industry Association/Telecommunications Industry Association (TIA/EIA), and Building Industry Consulting Service International (BICSI). The entire system and all components will be Nationally Recognized Testing Laboratory (NRTL) certified to appropriate TIA/EIA performance rating Category, Latest ANSI/TIA/EIA Standards 455-A, 492, 568, 569-A, 570, 606, 607 and 758 (latest revisions), and ANSI/TIA TSB 67, TSB 72, TSB 75, TSB 95 plus other standards as applicable.

G. The Installer will have available at the job site at all times one copy of the latest edition of the Electrical Code, TIA and BICSI Standards applicable to the work as specified within this document.

H. The above requirements will not in any way limit responsibility or requirements to comply with all other codes, standards and laws.

I. Material, equipment, enclosures, and systems will be designed for use as required to suit the conditions, exterior or interior operation, dust tight, water tight, explosion-proof, or other special types.

J. All materials shall be purchased from Distributors authorized by system Manufacturers to sell new and unused components.

1.04 DESCRIPTION OF WORK:

A. The extent of telephone/data system work is indicated and is hereby defined to include, but not be limited to cable, cable supports, raceway, connectors, racks, cabinets, panels, wire management, device plates, patch cords, backboard, grounding, firestop and miscellaneous items required for a complete, tested and operational system.

B. Provide, install and test the complete cable and outlet system as indicated and described herein. Work includes procurement, project management, installation, labeling, termination, testing and cleanup of all cables installed under this project.

C. Provide system testing, as-builts (redlines) of installed cables and numbering plan, Operations & Maintenance Manuals (O&M's), and processing of warranty registration with Manufacturer.

D. Project coordination with General Contractor, Owner, Owners Representative, and other trades before, during and upon completion of project as necessary for a well-executed project.

E. Refer to other Master Division sections, bid proposal and project responsibilities matrix for responsibility and requirements for raceways, boxes and fittings, wiring devices (plates), and supporting devices, and other sections, as applicable.

F. Horizontal cable and its connecting hardware provide the means of transporting signals between the telecommunications outlet/connector and the horizontal cross-connect located in the communications equipment room. This cabling and its connecting hardware are called "permanent link," a term that is used in the testing protocols.

G. Horizontal copper cabling system consists of four twisted pairs of solid annealed copper. Each four pair cable is terminated onto 8 position 8 conductor ("RJ45", or 8P8C) connectors (jacks) using Insulation Displacement Conductors (IDCs). Color-coded connectors are placed into NEMA rated faceplates at the work area and placed into corresponding rack-

mounted patch panels in the equipment / networking rooms. The jacks use state-of-the-art techniques to effectively eliminate Alien Crosstalk.

H. Horizontal cabling may contain no more than one transition point or consolidation point between the horizontal cross-connect and the telecommunications outlet/connector.

I. Bridged taps and/or splices will not be installed in the horizontal cabling.

J. Communications cables shall be rated CMR or CMP. CMP cable ratings are required for cables passing through or contained within plenum air handling spaces, such as above drop ceilings and return or supply air shafts. The contractor is responsible for installing the correct cable type in the appropriate environment, and any failures to do so according to the Owner or the Authority Having Jurisdiction (AHJ) will result in the contractor removing the unsuitable cable and installing the correct cable, at their own expense.

K. The maximum allowable horizontal cable length installed in the permanent link (jack to jack) is 295 feet (90 m). This maximum allowable length does not include an allowance for patch cords, maximum length of 16 feet (5 m) to the workstation equipment and of 16 feet (5 m) in the horizontal cross-connect.

1.05 QUALITY ASSURANCE:

A. Comply with applicable portions of NEC as to type products used and installation of components. Provide products and materials, which have been UL-listed and labeled. Comply with NEMA, ANSI and TIA standards manufacturer's recommendations for horizontal cabling.

1.06 SUBMITTALS

A. The Owner has standardized on a unified, end-to-end copper and optical fiber cabling system design based on Leviton jacks, patch panels, patch cords, fiber cords, fiber connectors, trunk cables, fiber enclosures and modules, as well as Berk-Tek field-terminable copper and fiber cables. The Owner is satisfied that the products specified herein are qualified for the purpose intended, and has performed due diligence in establishing a consistent set of standards based on performance and feature set.

B. Submit manufacturer’s data and installation details for all devices, plates, cable, terminal blocks, patch cords, racks, wire management, labels and similar equipment which are not in accordance with Owner standards.

1.07 CONTRACTOR QUALIFICATIONS AND TRAINING

A. The contractor shall be fully conversant and capable in the cabling of low voltage applications such as, but not limited to data, voice and imaging network systems. The Contractor shall at a minimum possess the following qualifications:

1. Possess those licenses/permits required to perform telecommunications installations in the specified jurisdiction.

2. Provide references of the type of installation provide in this specification.

3. Personnel trained and certified in fiber optic cabling, splicing, termination and testing techniques. Personnel must have experience using a light meter and OTDR.

4. Personnel trained in the installation of pathways and support for housing horizontal and backbone cabling.

5. Personnel knowledgeable in local, state, province and national codes, and regulations. All work shall comply with the latest revision of the codes or regulations. When conflict exists between local or national codes or regulations, the most stringent codes or regulations shall be followed.

6. Be in the Low Voltage or Telecommunications Installation business for a minimum of ten (10) years and possess current New Mexico ES-3 and ES-7 licenses with a service organization within 125 miles of the installation.

7. Be an approved Member in good standing of the Certified Installer network associated with the products listed in this Specification and authorized for use in this Project. Contractor must be a member of this installer program before, during, and through completion of the system installation. Supporting documentation will be required as part of the submittal.

8. Installing company to be Native American and Veteran owned.

1.08 WARRANTY

A. A Limited Lifetime Product & Performance Warranty covering all components, equipment and workmanship shall be provided to the Owner, submitted in writing with system documentation. The warranty period shall begin on the system's first use by the owner.

1. Horizontal channels shall be completed with Leviton Network Solutions factory-terminated copper and/or fiber optic patch cords in order to be eligible for the applicable Leviton Warranty with channel performance guarantees.

2. Approved product shall be listed on the most recent version of the applicable Leviton data sheets for each listed Berk-Tek Leviton Technologies solution.

3. The Contractor must pre-register the project with the Manufacturer before installation has begun. Following project completion, contractor is responsible for completing all warranty registration procedures on behalf of the Owner.

4. Should the cabling system fail to perform its expected operation within this warranty period due to inferior or faulty material and/or workmanship, the contractor shall promptly make all required corrections without cost to the owner.

B. Certified Installer shall provide labor, materials, and documentation in accordance with Leviton Network Solutions requirements necessary to ensure that the Owner will be furnished with the maximum available Manufacturer's Warranty in force at the time of this project.

C. The installed structured cabling system shall provide a warranty guaranteeing the specified performance in the installed channel performance above the ANSI/TIA-568 requirements for Augmented Category 6 (CAT 6A) cabling systems or ISO 11801 requirements for Class E_A.

1. Standards-compliant channel or permanent link performance tests shall be performed in the field with a Leviton-approved certification tester in the appropriate channel or permanent link test configuration.

D. Necessary documentation for warranty registration shall be provided to the manufacturer by the installer (within 10 days) following 100 percent testing of cables.

1. Installation Contractor shall submit test results to Leviton Network Solutions in the certification tester's original software files.

2. Installation Contractor shall ensure that the warranty registration is properly submitted, with all required documentation within 10 days of project completion.

3. Certified Contractor/Integrator must adhere to the terms and conditions of the respective manufacturer's warranty programs.

E. Manufacturer shall ensure that the Owner receives the project warranty certificate within 60 calendar days of warranty registration.

1.09 PRODUCTS INSTALLED BUT NOT SUPPLIED UNDER THIS SECTION

A. All conduit and EMT required for Communications cabling pathway in/out of cross connect closets and in/out of wall cavities at the work area. EMT or Conduit for pathways shall have no more than two 90 degree bends between pull boxes and no continuous section over 100'.

B. All core holes through concrete, metal, finished hardwood or masonry; in-floor troughs ("Walker Duct"), and poke through devices in the floor for the installation of Communications cabling. Device plates for landing communication cables should be included in the Communications scope.

C. All core holes and EMT sleeves between floors for the routing of Communications cabling.

D. Back boxes for the mounting of NEMA rated faceplates.

E. Drag line or pull string at the back boxes fished through existing EMT, conduit, or wall cavities ("Ring and String") to the accessible ceiling or other end of conduit, for installing 4 pair, multi-pair or fiber optic (horizontal and backbone) cables.

F. Minimum of 2 walls covered in ¾" AC grade plywood painted white with fire retardant paint in each cross connect closet or connection point for data, voice, video, security and building automation systems. Plywood walls shall be covered 4' W x 8' H whenever possible.

G. Basket tray or ladder racking to support main pathway cable bundles through hallways, open areas or exiting telecom rooms unless otherwise requested at time of bid.

H. #2/0 ground wire or other size as appropriate, from Telecommunications Grounding Bus Bar(s) to Building Ground. Use of #6 ground wire, or smaller as allowed, for grounding of telecommunications equipment installed under this Scope is included within the Telecommunications scope of work.

I. Electrical subcontractors may be required to provide additional lighting, power or grounding connections to the electrical panel, and to provide and install electrical devices as needed. It will be the responsibility of the Contractor to secure all required specialists and subcontractors in order to fully perform under the requirements for these projects.

PART 2 - PRODUCTS

2.01 GENERAL

A. Provide complete raceway, outlet boxes and miscellaneous items as required.

B. Utilize 4-$^{11}/_{16}$" square outlet box (min) at each outlet location with single gang plaster or tile ring and 1" conduit to cable tray, backboard, or accessible ceiling or floor space.

C. Provide a complete data cabling and device system as described herein.

D. Work area connectors shall be of a non-proprietary “Keystone”-style port configuration, such that they fit into all furniture, panels, wallplates, raceways, floor monuments, poke-throughs and AV boxes without adapters. Maximum density of 6 CAT6A outlets shall be available in Decora footprint where required and 48 ports in a 1RU panel may be required in select high density locations.

2.02 ACCEPTABLE MANUFACTURER SOLUTIONS:

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

1. Leviton Manufacturing Co, Inc.
2. Berk-Tek, a Nexans Company

2.03 UTP PIN/PAIR TERMINATION ASSIGNMENT

A. The UTP cabling system will have TIA/EIA T568B pin/pair termination assignment. All conductors provided will be properly and consistently terminated at both ends throughout the entire systems. Maintain proper untwist of pairs and removal of jacket per TIA, BICSI, and Manufacturer’s recommendations.

2.04 SYSTEM PERFORMANCE

A. Category 6A (CAT6A) Unshielded Twisted Pair (UTP) Systems

1. Category 6A 23AWG UTP copper cabling system shall be guaranteed to exceed all TIA-568 link and channel performance requirements and be capable of supporting 10G Base-T (802.3an) and ISO/IEC 11801 Class E_A applications for a total distance of 100 meters with equipment cords. System is guaranteed to meet all CAT6A requirements for short links and channels down to a 10 foot link (5 meter channel) with a guaranteed 5 dB margin of Alien Crosstalk. Field testing is not required for Alien Crosstalk clearance.

2. Basis of Design is Berk-Tek Leviton Technologies CX6850 Cat6A Premium UTP System

3. Category 6A Performance Parameters, headroom over TIA-568 standard:

Insertion Loss	NEXT	PSNEXT	ACR-F (ELFEXT)	PSACR-F (PSELFEXT)	Return Loss	ACR-N	PSACR-N	PSANEXT	PSAACR-F
3%	5 dB	6 dB	10 dB	10 dB	4 dB	7 dB	7 dB	5 dB	11 dB

B. CAT6A Shielded (F/UTP, or FTP) Systems

1. Horizontal FTP Category 6A 23AWG copper cabling system shall be guaranteed to exceed all TIA-568-C.2 link and channel performance requirements and be capable of supporting 10G Base-T (802.3an) and ISO/IEC 11801 Class EA applications for a total distance of 100 meters with equipment cords. System is guaranteed to meet all Cat 6A requirements for short links and channels down to a 10 foot link (5 meter channel) with a guaranteed 4 dB margin of Alien Crosstalk. Field testing is not required for Alien Crosstalk clearance.

2. Basis of Design is Berk-Tek Leviton Technologies CS6700 CAT6A Shielded System

3. CAT6A Shielded Performance Parameters, headroom over TIA-568-C standard:

Insertion Loss	NEXT	PSNEXT	ACR-F (ELFEXT)	PSACR-F (PSELFEXT)	Return Loss	ACR-N	PSACR-N	PSANEXT	PSAACR-F
3%	4 dB	6 dB	8 dB	8 dB	3 dB	7 dB	8 dB	16 dB	16 dB

C. Category 6 (CAT6) Unshielded Twisted Pair (UTP) Systems

1. Category 6 UTP 23AWG copper cabling system shall be guaranteed to exceed all TIA-568 link and channel performance requirements and be capable of supporting 1000Base-T (802.3ab) and ISO/IEC 11801 Class E applications for a total distance of 100 meters with equipment cords.

2. Basis of Design is Berk-Tek Leviton Technologies CX6175 CAT6 UTP System.

3. CAT6 Performance Parameters, headroom over TIA-568 standard:

Insertion Loss	NEXT	PSNEXT	ACR-F (ELFEXT)	PSACR-F (PSELFEXT)	Return Loss	ACR-N	PSACR-N
3%	6 dB	7 dB	8 dB	9 dB	3 dB	8 dB	9 dB

2.05 HORIZONTAL CABLING SYSTEMS

A. CATEGORY-RATED DATA CONNECTORS (RJ45 JACKS)

1. Provide mission-critical, modular-type, information connectors/outlets (jacks) for 24-23 AWG copper cable. These connectors shall be individual snap-in style, and exceed compliance with TIA-568 specifications. The connectors shall comply with the following:

   a. Shall be 8-position 8-conductor (8P8C) “RJ45”-style modular jack, Category 6 (CAT6) and/or Category 6A (CAT6A), with IDC terminals, T568A/B wiring scheme (use T568B), and utilize a non-punchdown simplified manual termination style.
   b. Shall be encased in a die-cast housing to protect from potential EMI/RFI, and utilize a universal Keystone-style insertion footprint as the manufacturer’s main “flagship” line of products.
   c. CAT6A connectors shall exceed all component performance requirements for Augmented Category 6 in the ANSI/TIA-568 standard, as well as Class E_A requirements as described in ISO/IEC 11801, from 1 MHz to 500 MHz to support the IEEE 802.3an standard for 10GBASE-T network performance.

d. CAT6 Connectors shall exceed all component performance requirements for Category 6 in the ANSI/TIA-568-C.2 standard, as well as Class E requirements as described in ISO/IEC 11801, from 1 MHz to 250 MHz.
e. Shielded connectors shall utilize the same form factor, design, and tool-less installation process as the unshielded connectors in the product line.
f. Shall be tested by an Independent testing body such as Intertek (ETL) for component compliance (i.e. “Component rated”) to ANSI/TIA-568 and for POE+ applications. Test results shall be published and publicly available without special request.
g. Shall be in compliance will all National Electrical Codes; compliant with ANSI/TIA-1096-A (formerly FCC Part 68); cULus Listed.
h. When used in the plenum spaces, shall be plenum-rated per UL 2043, and all plastic components shall be made of high-impact, fire-retardant plastic rated UL 94V-0.
i. Shall have a maximum depth of 1.31”.
j. Cable shall be terminated by the use of a snap-on wire manager that holds individual conductors in place during termination, and allows for termination without a complete untwist of each conductor pair. Cables shall terminate onto jack via a “clamshell” closure at rear of connector, affixing termination manager to connector IDC
k. Shall be terminated without the need for any punch down tool or other specialized or proprietary termination tool.
l. Shall be reusable and support a minimum 20 termination and re-termination cycles and be facilitated by simple termination release levers.
m. Shall utilize a method of tine tensioning using polymer springs above the tines (“Retention Force Technology” or similar functionality) that prevents six-position modular plug insertion from damaging either the cord or the module and promotes return of tines to original position.
n. Shall fit the full manufacturer’s range of telecommunications faceplates, outlets, and field-configurable patch panels. No separate product line or style of connectors shall be required for patch panels, faceplate, biscuit, furniture, raceway and/or floor feed applications.
o. Shall be available in 13 TIA 606-B compatible colors and supplied with interchangeable icons (Voice, Data, A/V, and blank, color coded to match the connector face) for easy identification and tracking of data, voice, or other functions. Additional bulk Icons for the connector shall be available separately.
p. Shall be available with an optional internal shutter to protect against dust and debris such as in above-ceiling and in-floor locations.

Approved Products:
Leviton Atlas-X1 UTP Cat 6A Connector, no shutters, 6AUJK-R*6
Leviton Atlas-X1 UTP Cat 6A Connector, with shutters, 6AUJK-S*6
Leviton Atlas-X1 STP (Shielded) Cat 6A Connector, no shutters, 6ASJK-R*6
Leviton Atlas-X1 STP (Shielded) Cat 6A Connector, with shutters, 6ASJK-S*6
Leviton Atlas-X1 UTP Cat 6 Connector, no shutters, 61UJK-R*6
Leviton Atlas-X1 UTP Cat 6 Connector, with shutters, 61UJK-S*6
Additional Icons: ICONS-IC* (72 two-sided Icons)

Where * = one of 13 colors. See drawings or check with Owner for application.
(W)=White, (T)=Light Almond, (A)=Almond, (I)=Ivory, (Y)=Yellow, (O)=Orange, (L)=Blue, (B)=Brown, (C)=Crimson, (R)=Dark Red, (P)=Purple (V)=Green, (G)=Grey, (E)=Black

B. PATCH PANELS

1. Telecommunications Room Patch panels shall be manufactured with empty ports, which allow for the insertion of appropriately-graded and colored jacks. Panels shall be Shielded, standard density, and used for all CAT6 and CAT6A terminations at IDF and MDF locations. Panels shall be:

a. Unshielded for UTP, and Shielded for either FTP or UTP applications, and shall accept both styles (UTP/FTP) of jacks in the same panel. Shielded panels shall include star washers and grounding lug for flexibility in panel grounding, and/or hardware to accept standards-compliant grounding connectors.
b. Available in either 24- or 48-ports.
c. Independently tested and verified by Intertek (ETL) to meet or exceed all TIA component, permanent link, and channel requirements of TIA-568 for Cat 5e, Cat 6, and Cat 6A, FCC part 68, and IEC 60603-7. An appropriate cable management bar shall be included with standard density flat panels.
d. QuickPort High-Density modular panels shall be available in 48-ports/1RU form factors for authorized situations.
e. Shall be sized to fit an EIA standard, 19 inch relay rack and hole pattern.
f. Shall utilize a universal Keystone-style insertion footprint as the manufacturer's main "flagship" line of products and receive the same jacks as are used in the workstation outlets. No special "Panel jack" shall be required.

Approved Products:
Leviton QuickPort® Shielded Angled Patch Panel # 4S256-*xx
Leviton QuickPort® Shielded Flat Patch Panel # 4S255-*xx
Leviton QuickPort® Angled Patch Panel # 49256-*xx
Leviton QuickPort® Flat UTP Patch Panel # 49255-H24 (1RU) or 49255-H48 (2RU)
Leviton QuickPort® Flat UTP 1RU 48-port Patch Panel # 49255-Q48

Where:
xx = # of ports per panel
* = S (Shielded), H (24 ports per RU), D (48 ports per RU)

C. FACEPLATES

1. Faceplates (wallplates) secure information outlets to the work area. Contractor shall provide and install single gang faceplate kits to house all jacks as required for all work area outlets, workstation base feeds, and furniture openings. Unused telecom backboxes shall receive a solid blank faceplate. Telecommunications faceplates shall:

a. Utilize a keystone-type ("QuickPort") footprint to match the approved connectivity manufacturer, and be made by the same manufacturer as the connectors.
b. Precisely match colors and materials of the power wiring device plates.
c. Support any connectivity media type, including fiber, AV and copper applications.
d. Have write-on or printable designation labels for circuit identification together with a clear plastic cover.
e. Be available in single-gang and double-gang configurations.
f. Have surface-mount boxes and standoff rings available for both single and double gang faceplates.
g. Have single-port matching color blank inserts available in packs of 10.
h. Color shall match nearby electrical devices exactly. Off-color ivories or whites will not be accepted.
i. Furniture faceplates shall fit existing knockouts for telecom receptacles, and snap in without screw mounts.

Approved Products:
Leviton QuickPort Single-Gang, Plastic, with ID Windows, # 42080-#xS
Leviton QuickPort Single-Gang, Stainless Steel, with ID Windows, # 43080-1L#
Leviton QuickPort Blank Inserts, pack of 10, #41084-BxB
Leviton QuickPort Single-Gang Stainless Steel Wall Phone faceplate, #4108W-0SP
Leviton Blank Plate #zz014 (1-gang), xx025 (2-gang)

Leviton Extended-Depth Furniture Faceplate, #49910-Ex4

Where:
# = number of ports: 1, 2, 3, 4, 6
x = color: White (W), Ivory (I), Light Almond (T), Gray (G), Black (E)
zz= 88 (White), 77 (Lt. Almond), 86 (Ivory), 88 (Stainless Steel)

D. SURFACE-MOUNT BLOCKS (SMB)

1. Surface-Mount Blocks (SMBs) are used to protect terminated CAT6 and CAT6A cables at the endpoints where they are not contained within walls or furniture. Example locations may be Wireless Access Points (WAPs), Group Work Areas fed by conduits run down columns, security cameras, or other network-enabled device locations.

2. Ceiling, WAP, Camera and other non-wallmount locations will use a 2-port plastic SMB.

3. Small Surface-Mount Boxes shall exhibit the following characteristics:

   a. Outlet housings for WAPs and other devices shall be a high-density, low profile design with (2) or (4) field-configurable ports, snap-lock cover, and cable knockouts on back.
   b. Housing cover shall have raceway knockouts for top and bottom entry. Base shall include Tie-wrap anchor points at all cable entrances.
   c. The housing shall be mountable with screws, tape or a single magnet.
   d. The cover shall provide the option of securing it to the base with a screw that is hidden under the outlet identification window.
   e. Shall be constructed of high-impact self-extinguishing plastic rated UL 94V-0, and be UL Listed and compliant with FCC Part 68 and TIA-568 specifications.

Approved Products:
Leviton QuickPort Surface-mount Housing, White, #41089-#xP

Where
# = number of ports: 1, 2, 4, 6
x = color: White (W), Ivory (I), Light Almond (T), Gray (G), Black (E)

E. DATA CABLES

1. Category 6A (CAT6A) Unshielded Twisted-Pair (UTP) cable

   a. 100-Ohm, 23 AWG, Category 6A 4-pair balanced unshielded twisted pair solid annealed copper
   b. Cable shall be characterized to 750 MHz and UL/ETL Listed by the Manufacturer printed on the cable jacket and package, as well as Intertek (ETL) Verified to TIA-568 Category 6A and ISO/IEC 11801 Class E_A requirements for channel, link and component performance to support IEEE 10GBASE-T (802.3an) networks
   c. Maximum Cable Outer Diameter: 0.275".
   d. Documentation available from an independent third-party testing agency that verifies through random sampling that cable components perform at or above the levels contained on their product specifications, not simply at or above the standard.
   e. Guaranteed cable balance improves overall performance and reduces emissions which results in error-free performance up to 10 Gigabit Ethernet with full duplex transmission
   f. The unshielded twisted pair conductors are surrounded by a non-conductive aluminum/polyester tape and jacketed with flame-retardant polymer alloy to reduce

alien crosstalk, reduce cable diameter and improve performance.
g. Provided on spools or reels-in-box to reduce risk of kinking cable upon deployment
h. Cable shall be Plenum-rated (CMP) for any location where plenum cable is required.
i. Color: Blue, or as directed.
j. Be made by an ISO 9001 and 14001 Certified Manufacturer.
k. Guaranteed to meet or exceed Channel margin guarantees as stated above under System Performance

2. Category 6A (CAT6A) Shielded, or Foiled Twisted Pair (FTP) cable

a. 100-Ohm, 23 AWG, Category 6A 4-pair balanced twisted pair solid annealed copper with a single overall foil shield.
b. Shielded with an overall polyester/aluminum foil with stranded tinned copper drain wire and ripcord and jacketed in flame-retardant PVC
c. Characterized to 750 MHz, 75ºC and UL/ETL Listed by the Manufacturer printed on the cable jacket and package, as well as Intertek (ETL) Verified to TIA-568 Category 6A and ISO/IEC 11801 Class E_A requirements for channel, link and component performance to support IEEE 10GBASE-T (802.3an) networks
d. Maximum Cable Outer Diameter: 0.280".
e. Documentation available from an independent third-party testing agency that verifies through random sampling that cable components perform at or above the levels contained on their product specifications, not simply at or above the standard.
f. Guaranteed cable balance improves overall performance and reduces emissions which results in error-free performance up to 10 Gigabit Ethernet with full duplex transmission
g. Provided on spools to reduce risk of kinking cable upon deployment
h. Cable shall be Plenum-rated (CMP) for any location where plenum cable is required.
i. Color: White, or as directed.
j. Be made by an ISO 9001 and 14001 Certified Manufacturer.
k. Guaranteed to meet or exceed Channel margin guarantees as stated above under System Performance

3. Category 6 (CAT6) Unshielded Twisted-Pair (UTP) cable

a. 100-Ohm, 23 AWG, Category 6 4-pair balanced unshielded twisted pair solid annealed copper conductors
b. Cable shall be characterized to 550 MHz and UL/ETL Listed by the Manufacturer printed on the cable jacket and package, as well as ETL Verified to TIA-568 Category 6 and ISO/IEC 11801 Class E.
c. Cable shall be Plenum-rated (CMP) for any location where plenum cable is required.
d. Color: Blue, or as directed.
e. Outer Diameter: 0.230" max.
f. Cable shall be guaranteed to exceed all TIA-568 link and channel performance requirements and be capable of supporting 1000Base-T (802.3ab) and ISO/IEC 11801 Class E applications for a total distance of 100 meters with equipment cords

4. All category cabling manufacturers must be able to provide documentation from an independent third-party testing agency that verifies through random sampling that cable components perform at or above the levels contained on their product specifications, not simply at or above the standard.

5. Cable may be CMR rated for areas not running through air handling spaces. CMP cable must be used if cable passes at any point through an air plenum or supply/return air handling space.

Approved Products:
Berk-Tek LANmark XTP, CAT6A CMP, Blue, 1000' reel, # 11082057
Berk-Tek LANmark XTP, CAT6A CMR, Blue, 1000' reel, # 11082062
Berk-Tek LANmark-10G FTP, CAT6A CMP, White, 1000' reel, # 10167485
Berk-Tek LANmark-10G FTP, CAT6A CMR, White, 1000' reel, # 10189801
Berk-Tek LANmark 1000, CAT6+ UTP, Blue, CMP, 1000' box, # 10032094
Berk-Tek LANmark 1000, CAT6+ UTP, Blue, CMR, 1000' box, # 10032455
Other colors as required

F. COPPER PATCH CORDS

1. Copper patch cords for CAT6A UTP and FTP cable systems shall exhibit the following characteristics:

    a. Patch cord plug shall be a Slimline, integrated snag-less plug design made of industry standard, FCC compliant 94V-0 clear material without incorporating the use of a rubber molded overboot.
    b. A narrow profile for less congestion in higher density applications and a clear plastic strain relief boot ensures long-term network performance
    c. Independently tested and verified by Intertek (ETL) for CAT 6A component performance.
    d. Cable construction provides excellent alien crosstalk suppression and EMI/RFI protection.
    e. Constructed of shielded 26 AWG stranded conductor cable for maximum flexibility and outside diameter of .240", for use in shielded and unshielded systems.
    f. Patch cords in Plenum areas shall be Plenum-rated, and utilize solid conductors.
    g. Complies with TIA 568-C.2-10 component requirements for connecting hardware from 1 MHz to 500 MHz, ISO 11801 Class E_A, IEEE 802.3an to support 10GBASE-T networks and cULus listed. Patch cords shall meet ANSI/TIA-1096-A requirements to include 50 micro inches of gold plating.
    h. The patch cord jacket shall meet or exceed UL 444 CM rating and be RoHS compliant.
    i. The patch cords shall be available in standard 3, 5, 7, 10, 15, and 20 foot lengths. Custom lengths from 1' and above shall also be available through a made to order program.
    j. The patch cord shall be available in 7 standard colors.

2. Standard copper patch cords for CAT6 UTP user locations shall exhibit the following characteristics:

    a. 26-gauge, unshielded, twisted pair, stranded conductor construction with a standard 8-position modular plug on both ends.
    b. Plug contacts shall be plated with minimum of 50 micro-inches (µm) of gold
    c. Slimline, integrated snag-less molded plug design with integrated strain relief, without incorporating the use of any secondary or 2-piece rubber over-boot.
    d. Maximum Outer Diameter of 0.24"
    e. Power over Ethernet (PoE and PoE+) compatible
    f. Support 1 Gigabit applications over 90-meter permanent links with up to 10 meters of cordage
    g. Meets all applicable standards and listings: ANSI/TIA-1096-A (formerly FCC Part 68), RoHS compliant, IEEE 802.3, PoE: IEEE 802.3at – 2012
    h. Color: White

3. High-flex copper patch cords for CAT6 UTP cable systems used inside Telecom Enclosures, Rooms and racks shall exhibit the following characteristics:

a. 28-gauge, unshielded, twisted pair, stranded conductor construction with a standard 8-position modular plug on both ends.
b. Plug contacts shall be plated with minimum of 50 micro-inches (μm) of gold
c. Slimline, integrated snag-less molded plug design with integrated strain relief, without incorporating the use of an secondary or 2-piece boot.
d. Ultra narrow, highly flexible cord for less congestion in higher density applications
e. Maximum Outer Diameter of 0.15", minimum bend radius 0.60"
f. Power over Ethernet (PoE and PoE+) compatible
g. Support 1 Gigabit applications over 90-meter permanent links with up to 6 meters of cordage
h. Meets all applicable standards and listings: ANSI/TIA-1096-A (formerly FCC Part 68), RoHS compliant, IEEE 802.3, PoE: IEEE 802.3at – 2012
i. Color: White
j. To be used at patch panel end of any CAT6 permanent link.

4. Provide and install only factory-assembled patch cords of the same or better Category rating of the permanent link cabling system, in quantities as described in Part 3 of this Specification.

Approved Products:

Leviton Slimline Atlas-X1 CAT6A Component-rated Patch Cord, Blue, # 6AS10-xx*
Leviton Plenum-rated CAT6A Component-rated Patch Cord, Blue, # UAPPP-xx*
Leviton Slimline eXtreme CAT6 Component-rated Patch Cord, White, # 6D460-xx*
Leviton High Flex 1G HD6 Patch Cord, for CAT6 systems, White, # 6H460-xx*

Where:

xx = Length, in Feet.
* = one of 13 colors. (W)=White, (Y)=Yellow, (L)=Blue, (R)= Red, (G)=Green, (S)=Slate Grey, (E)=Black

2.06 BACKBONE CABLING SYSTEMS

A. GENERAL

1. Copper cables allowed for use in the backbone include: 4-pair 100-ohm unshielded twisted-pair 100% annealed-copper solid-conductor cables, 100-ohm UTP multi-pair copper cables. Fiber optic backbone cables shall be 50/125μm Laser-Optimized Multimode Fiber and 8.3μm low-water peak singlemode optical fiber cables compliant with ITU-T G.652D (or OS2). The cable shall support voice, data, and multimedia applications. The bending radius and pulling strength requirements of all backbone cables shall be observed during handling and installation.

B. VOICE COPPER BACKBONE CABLE

1. Power-Sum Multi-Pair Category 3 cable, 24 AWG solid-copper conductors in 25-pair binder groups to support 10BASE-T, 100BASE-T and Analog Voice communications at 16Mhz.

2. Copper backbone cables shall be terminated onto a rack-mounted modular RJ45-style patch panel.

3. Terminate Category 3 cables onto Category 5e patch panels at 1 pair per port, with the last of the 25-pair cable coiled (full length) for future use. Use black outlet colors on patch panel for Category 3 connectivity.

Approved Products:
Leviton 24-port 110 punchdown patch panel, #5G596-U24
Berk-Tek # 10032111, 25-pr CMP, Gray.
Berk-Tek # 10032396, 25-pr CMR, Gray
Other multiples of 25 acceptable (50, 100, 200, 300pr as required)

C. OPTICAL FIBER CABLE

1. SINGLEMODE Optical Fiber

a. Optical fiber cables run shall be low-water-peak Singlemode (OS2), and meet all of the requirements delineated within the specifications of ANSI/TIA-568 and ANSI/TIA-492.AAAC-B.
b. Armored fiber optic cables will utilize an interlocking armor outer cover around an integrated tight-buffer (indoor only) or Loose-Tube (indoor/outdoor) cable construction. Plenum armored fiber may be run in open ceilings without conduit or innerduct.
c. Indoor fiber optic cable shall be minimum 12 strands, tight buffered, and individual fiber strands shall be 900 micron jacketed.
d. Outdoor or indoor/outdoor fiber optic cable used for building-to-building interconnections shall be minimum 24 strands, loose tube construction with 250 micron unjacketed fiber strands in a 12-strand buffer tube.
e. Cables are typically OFNR rated for in-conduit applications, but must always be constructed of materials and rated appropriate for the environment in which it is installed (Indoor, Indoor/Outdoor, Outside Plant (OSP), OFNP or OFNR, OFCP or OFCR). In-slab conduits are considered a “wet environment” and require OSP or Indoor/Outdoor rating. Cables running at least a portion of the length through an open-air plenum or air handling space must be OFNP or OFCP (plenum) rated. Contractor is solely responsible for installation of the correctly-rated cable in the appropriate environment, as required by the AHJ or local ordinance
f. Loose tube fibers shall utilize a fan-out kit to fit 250 micron fibers into a 900 micron protective sheath when terminating. Loose Tube cables are generally expected for outdoor environments.

Approved Products:
Berk-Tek Premises Indoor Tight Buffer Plenum cable, 12-strand, # PDP012AB0707
Berk-Tek Premises Indoor Armored Tight Buffer Plenum cable, 12-strand, # PDPK012AB0707
Berk-Tek Adventum Indoor/Outdoor Dry Loose-Tube Plenum cable, 24-strand, # LTP12B024AB0403
Berk-Tek Adventum Indoor/Outdoor Armored Dry Loose-Tube Plenum cable, 24-strand, # LTPK12B024AB0403
Leviton 12-fiber, 24” fan-out Kit, # 49887-12S

2. MULTIMODE FIBER OPTIC CABLE – FIELD TERMINATED

a. Multimode fiber optical fiber cables shall meet all of the requirements delineated within the specifications of ANSI/TIA-568 and ANSI/TIA-492.CAAB (OM4). Must be a minimum of 12 strands, typically 24 strands, of Laser-Optimized 50 micron optical fiber. Cable jacketing must be appropriate for the environment in which it is installed (Indoor, Indoor/Outdoor, Outside Plant, OFNP or OFNR).
b. Fiber optic cables will utilize an interlocking armor outer cover around an integrated Tight-Buffered (indoor only) cable construction and fiber strands with a 900 micron protective sheath.
c. See plans and scope of work for total strand count between locations.

Approved Manufacturers

Berk-Tek Indoor Plenum tight buffered cable, 12-strand OM4 Armored, # PDPK012FB3010/25

Berk-Tek Indoor Plenum tight buffered cable, 24-strand OM4 Armored, # PDPK024FB3010/25

Berk-Tek Adventum Indoor/Outdoor Plenum cable, 12 strand, # LTP012FB3010/25

Berk-Tek OSP cable, Loose Tube 12-strand, # OPD012FB3010/25

Leviton 12-fiber, 24" fan-out Kit, # 49887-12S

* Or other strand counts as specified

3. MULTIMODE FIBER OPTIC CABLES – FACTORY PRETERMINATED

a. Optical fiber cables shall meet all of the requirements delineated within the specifications of ANSI/TIA-568. Cables must be a minimum of 24 strands of 50/125µm (micron) OM4 Laser-Optimized Multi-Mode Fiber (LOMMF) for backbone cabling. Cables must be appropriate for the environment in which it is installed (Indoor, Indoor/Outdoor, OFNP or OFNR) but are not suitable for Outside Plant (aerial or underground). Backbone cables may be used rack-to-rack, MDF-to-IDF, or similar intrabuilding applications.

b. Pre-terminated backbone cables will utilize the MTP® connector, employing a multi-strand ferrule capable of supporting 1G, 10G, 40G or 100G Ethernet and beyond. The MTP® connector is not a field-installable connector, and must be factory polished and tested to ensure precise fiber alignment and finish.

c. All optical fiber backbone cables (trunks) shall be factory terminated, dry loose tube, armored jacket, Laser Optimized 50 micron OM4 for plenum-rated applications. All trunks shall be labeled on both ends with machine labeling and bar coded with unique numbers. Labels shall be highly visible with white background and black lettering, and shall list origination and destination on both ends before break of individual legs. All Fiber Trunk assemblies shall possess the following characteristics at a minimum:

1) Meet or exceed TIA 568 for OM4 performance at 550 meters for 10 Gigabit and 150 meters for 40 Gigabit or 100 Gigabit transmissions.
2) Optical fiber jackets shall be durable jacketed construction utilizing loose tube design, aramid yarn, and fiberglass strength members for protection.
3) Optical fiber cable trunks shall have a minimum breakout of 3 feet. All fiber trunks shall utilize a heat shrink at the ends of all breakouts to create a smooth breakout of the fiber subunit legs.
4) Optical fiber subunits shall utilize a round construction. Ribbon construction is not acceptable.
5) All fiber connectors must meet TIA 604.X for compatibility.
6) All Multimode optical fiber subunits of 24 strands shall utilize the 24-strand MTP connector. Optical Fiber subunits of 12 strands shall utilize a 12-strand MTP connector. No optical fiber subunits shall be smaller than 12 strands except for fiber optic jumpers used within the same racks.
7) Multimode fiber optic trunks shall utilize female MTP connectors. 24-strand MTP connectors shall have a Red boot, and 12-strand MTP shall use a Black or Aqua boot.
8) Singlemode MTP connectors shall be 12-strand, Angle-Polish, and shall have a Green boot.
9) Manufacturer shall provide MTP® brand connectors for specific superior performance characteristics. Generic MPO-style connectors are not acceptable quality. Use of only ferrules or other essential components will not be

acceptable, but only the complete MTP system of components used at each connector assembly.

10) All MTP connectors shall be laser cleaved to increase hardness of tip and precision of end product.
11) All Multimode Fiber Optic Trunks shall utilize Method B Polarity. Singlemode fiber optic trunks shall utilize Method C.
12) All optical fiber cabling trunks shall have a unique identifying label with a bar code for quick identification. The label shall state Manufacturer, trunk length and serial number. Custom labeling shall be available from the manufacturer as an option to aid in deployment during construction.
13) A pulling eye shall be installed on one end of all trunks to help facilitate installation.
14) All optical fiber trunks shall be shipped to project site with a number on the box that will correspond to the layout of the facility for easy identification by the Vendor. All fiber trunks shall include a printed summary test file of all fiber strands inside the box for the Vendor. Additionally, the Manufacturer shall hold all full test data until the project is complete and provide them to Owner along with the applications assurance warranty after the project is completed
15) Installation contractor will re-test all fiber trunks upon completed installation and provide test results to Manufacturer for completion of full product warranty requirements.
16) The contractor shall be responsible for the correct fiber trunk lengths, configuration, and ordering. Fiber Trunk part numbers shall be generated from Leviton.com Online Configurator and must be verified with the Manufacturer prior to ordering.

Approved Products:
Leviton Unity Part # FT-FC024JJ100F38C38CY-NNBS (sample part #, actual part # TDB as required)

Where:

FT	Fiber trunk
F	(F=OM4)
C	Dry loose tube, A = Riser, B = Plenum, C = Armored Plenum jacket
024	24-strand fiber cable
JJ	Female 24-strand MTP® on each end (LL= 12-strand MTP)
100F	100’ (use 3-digit length and M for meters)
38	38” breakout, end 1
C	3mm jacketed fiber breakout leg
38C	38” breakout, 3mm tubing, end 2
Y	Pulling eye (Yes)
NN	Staggered ends, 1st and 2nd end both (YY, NN, YN, NY options)
B	Polarity Method (B)
S	Standard labeling (C for Custom, supply spreadsheet with order)

D. FIBER OPTIC ENCLOSURES, PANELS AND TRAYS

1. All Fiber enclosures shall provide cross connect, inter connect, and splicing capabilities and contain cable management for supporting and routing the fiber cables/jumpers.

2. Fiber Adapter panel openings shall accept Fiber Adapter Plates (bulkheads), Splice Modules, and plug-n-play MTP modules/cassettes or any combination thereof.

3. 1RU, 2RU and 4RU enclosures shall hold up to 3, 6 or 12 adapter plates or cassettes, respectively.

4. All Fiber enclosures, panels and trays (units) shall provide cross-connect, inter-connect, and splicing capabilities and contain cable management for supporting and routing the fiber cables/jumpers.

5. Fiber enclosures shall exhibit the following characteristics:

    a. Fiber enclosure shall be available in 1RU, 2RU or 4RU versions to accommodate fiber adapter plates, MTP Modules, and/or termination and splicing of fiber as needed
    b. Enclosure shall inherently accept a 1-panel integrated splice cassette.
    c. Enclosures shall have a sliding tray which can be removed completely from enclosure (from front or rear) to facilitate field terminations and splicing. Sliding tray glides forward and backward providing accessibility to front and rear bulkhead after installation.
    d. 17" depth for high density fiber termination and/or splicing.
    e. Removable transparent hinged doors and slide away covers allow easy access during install and visibility of interior after installation.
    f. Patch cord bend radius guides minimize macro bending.
    g. Stackable and adjustable fiber rings simplify cable routing and organization
    h. Fiber Jumper saddles pivot for improved patch cord routing and organization
    i. Removable rubber grommets protect cable and minimize dust build-up
    j. Multiple mounting bracket positions for 19" or 23" rack and cabinet installation (23" 1RU mounting bracket sold separately)
    k. Constructed of durable polycarbonate plastic and 16 gauge steel, powder-coated black
    l. Door lock option available on front, rear, or both doors
    m. Fiber cable management shall allow for routing, storage, and protection of patch cords, tight-buffer fiber, and backbone cables.
    n. Enclosure shall be available either empty or in custom pre-loaded configurations.

Approved Products:
Leviton Opt-X SDX 2000i Rack-Mount Enclosure, #5R1UH-S03 (1RU)
Leviton Opt-X SDX 2000i Rack-Mount Enclosure, #5R2UH-S06 (2RU)
Leviton Opt-X SDX 2000i Rack-Mount Enclosure, #5R4UH-S12 (4RU)
Leviton armored cable ground kit, # DPGRD-KIT

E. FIBER TERMINATION PRODUCTS

1. FIBER OPTIC SPLICE CASSETTES AND MODULES

    a. Use of fusion splice cassette assemblies shall be the standard means of splicing fiber optic cables at the enclosure.
    b. Fiber Optic Splices shall be done using fusion splice equipment. Mechanical splices are not permitted.
    c. Splice cassettes shall be offered in 12- or 24-fiber LC configurations in OS2 fiber type. Construction of module shall be of 14-gauge aluminum for robustness and light weight.
    d. Splice cassettes shall be pre-loaded and routed with respective 3-meter, color-coded pigtail assembly.
    e. Individual OS2 pigtails shall have maximum insertion loss of 0.3 dB. Return Loss shall be greater than 55 dB.
    f. Individual compartments shall provide slack storage and bend radius protection for incoming backbone fibers, 900 µm tight-buffer fibers, and fusion-spliced fibers.
    g. Incoming 250 µm backbone fibers shall be protected by a braided mesh sleeve. Heat shrink style splice sleeves, braided mesh sleeve, and tie wraps shall be included with module.

Approved Products:
Leviton Opt-X 12-Fiber LC Singlemode OS2 Splice Module # SPLCS-12L
Leviton Opt-X 24-Fiber LC Singlemode OS2 Splice Module # SPLCS-24L

2. FIBER CONNECTORS

a. Pre-polished fiber optic connectors shall be the primary means of field-terminating individual fiber strands at the enclosure or faceplate location.
b. Shall meet or exceed the requirements described in TIA-568 and ANSI/TIA-604-10 (LC) Connector Intermateablity Standards
c. Shall be pre polished and field installable to eliminate the need for hand polishing, bonding, or epoxy in the field.
d. Shall utilize a precision zirconia ceramic ferrule, and be re-terminable up to 3 times during testing without loss of performance.
e. Shall require the use of a cleaver with a guaranteed maximum cleaving angle of 2 degrees for multimode and 1 degree for singlemode fibers.
f. Shall be provided in LC, single-mode or multimode (laser optimized) configurations, terminated on 250 or 900 µm buffered fiber and/or 2mm or 3 mm jacketed fiber.
g. Maximum connector insertion loss shall be no greater than 0.5 dB, with an average of 0.1 dB (MM) or 0.2dB (SM). Typical connector return loss shall be 35 dB (multimode) and 56 dB (single mode). All versions shall allow continuity to be verified by use of a visual fault locator (VFL).

Approved Products:
Leviton FastCAM LC Singlemode, # 49991-SLC
Leviton FastCAM LC Multimode LOMMF, # 49991-LLC
Leviton / Lynx cleaver # 49886-LNX or equal

3. FIBER ADAPTER PLATES

a. The fiber adapter plate shall be modular and functional for use in either a wall-mount or rack-mount enclosure. The adapter plate shall be provided in LC styles, in 12- or 24-fiber configurations. 12-fiber adapter plates are used to terminate 12-fiber cables, and 24-fiber adapter plates are used to terminate 24-fiber (or greater) cables. Do not utilize adapter plates with unused ports at the rear.
b. The adapter plate shall be compliant to TIA-568 (for performance) and respective TIA-604-X (for intermateability) standards. Adapter plates shall use zirconia ceramic sleeves and be offered in standard fiber type colors pursuant to TIA-568 standards.
c. LC adapter plates shall be precision-molded in the USA and integrated to eliminate “rattle” and loose fit. All ferrules shall be zirconia-ceramic. Adapter plates shall be offered in standard fiber type colors. Singlemode color shall be BLUE.

Approved Products:
Leviton Opt-X Fiber Adapter Plate, 12 LC SM Blue, #5F100-2LL
Leviton Opt-X Fiber Adapter Plate, 24 LC SM Blue, #5F100-4LL
Leviton Opt-X Fiber Adapter Plate, 12 LC LOMM Aqua, #5F100-2QL
Leviton Opt-X Fiber Adapter Plate, 24 LC LOMM Aqua, #5F100-4QL

4. MTP® MODULES FOR PRE-TERMINATED CABLES

a. 24-strand Multi-Mode Fiber optic MTP-MTP configured trunks which terminate in LC connectors will land on a 24-strand (12 LC Duplex Port) MTP-LC Cassette module and will utilize a 24-strand MTP connector at each end of the trunk. 12-strand Multi-Mode Fiber optic MTP-MTP configured trunks which terminate in LC connectors will land on a 12-strand (6 LC Duplex Port) MTP-LC Cassette module using 12-strand

MTP connectors.

b. 24-strand Multi-Mode Fiber optic MTP-MTP configured trunks which terminate in MTP 40G connectors will land on an MTP - MTP Cassette module with (3) 8-strand MTP connectors on the front. Trunks utilizing 2 or more 24-strand MTP connectors may land on a MTP module displaying (2) 24-strand MTP connectors in the rear, and (6) 8-strand (40G) MTP connectors in the front. Multiple modules may be required if trunk cables are configured with greater strand counts or connectors.
c. 12- or 24-strand Singlemode Fiber optic MTP-LC cassettes shall be configured with 12-strand MTP connections in rear.
d. The MTP modules shall meet the following requirements:

    1) Insertable directly into fiber enclosure panel openings with a push-pin/grommet latch.
    2) Rated for Laser Optimized Multi-mode OM4 optical fiber or OS2 Singlemode.
    3) Multimode shall utilize Method B Polarity and Singlemode uses Method C.
    4) Multimode shall require one Core module at one end of a fiber trunk segment, and one Edge module at the second end to maintain correct polarity across the system. Core modules will be used at the MDF and Edge modules at the IDF ends of the cable for consistency of design.
    5) Singlemode modules shall utilize Method C at both ends of the fiber trunk cable.
    6) 40G MTP connector housings at front of module shall be Black.

Approved Products:

Leviton 24-fiber MTP (rear) to LC module, # FM-*024CDC0x
Leviton 24-fiber MTP (rear) to 3x8-fiber MTP 40/100G module, # FM-F024NDC0x

Where:

* = A (OS2), F (OM4)
x = BC (Method B Core), BE (Method B Edge)

5. FIBER JUMPERS AND ARRAY CORDS

a. Fiber optic LC-LC patch cords, or jumpers, will make LC connections from the rack termination points to the equipment. The jumpers will meet the following requirements:
    1) Factory-manufactured using Singlemode OS2 optical fiber. Field terminations on fiber jumpers are not acceptable.
    2) Shall utilize A-B polarity.
    3) Shall exhibit <0.3 dB insertion loss and -25 dB return loss.
    4) Shall be available in standard lengths of 1, 2, 3, 5 and 10 meters and custom-orderable up to any length of feet or meters
    5) Provide factory assembled patch cords meeting or exceeding all criteria specified in the horizontal cabling standard
    6) Verify lengths, quantities and configuration with owner prior to delivery.

b. Fiber-Optic MTP-MTP “array cords” shall utilize 8-strand MTP (female) to 8-strand MTP (male) connectors in a 3mm breakout jacket. The array cords will meet the following requirements:

    1) Array cords shall meet an optical insertion loss not to exceed 0.35 dB per mated connector pair.
    2) Array cords shall be available in 1-, 2-, 3-, 5-, and 10-meter lengths.
    3) Array cords shall be compliant with TIA-568-C.3 and IEEE 802.3ba and available in UL Riser or Plenum rated cables (Riser is acceptable for in-rack patching)

4) Meets TIA-568-C.3 and IEEE 802.3ba standards (40/100GbE), and adheres to TIA-942 data center design guidelines.
5) Boot color for 8-strand MTP array cords shall be Dark Gray.
6) MTP shall be pinned on one end, unpinned on the other, and utilize Method B polarity.

Approved Products:
Leviton LC-LC SM duplex jumper, UPDLC-Sxx
Leviton LC-LC MM OM4 duplex jumper, 54DLC-Mxx
Leviton 8-Fiber MTP(f)-MTP(m) Method B OM4 array cord, #548MN-BxxM

Where:
xx = Length in Meters (01, 02, 03, 05 or 10) as required

2.07 AUDIO VISUAL SYSTEMS

A. HDBASE-T DEVICES

1. GENERAL

a. Units shall be certified by the HDBaseT Alliance to ensure compatibility and performance.
b. Class 2 Extenders shall be Certified to support plug-and-play installation including HD video, multi-channel audio, bi-directional power, bi-directional IR, and RS-232 control.
c. Class 1 Extenders shall include support for all Class 1 devices with the addition of HDBaseT 5Play™ 100Mb Ethernet, up to 100 meters.
d. Extenders shall be compatible with and support key features of HDMI 1.4 including EPG, CEC, EDID, and HDCP.
e. Extenders shall include bi-directional PoH (power over HDBT), IR, RS-232.
f. Transmitter and receiver shall include power, operating status, link and HDCP status indicator LEDs to aid in setup
g. Transmitter and receiver shall be FCC Part 15; subpart B, Class B compliant
h. Locking feature for HDMI and power input connections shall be included. Extender transmitter and receiver shall have a metal enclosure and include mounting brackets.
i. Extender sets shall also include RS-232 interface cables and DC power adapter with a set of interchangeable international input plugs.
j. Extender sets shall support IR emitter and target kit for bi-directional control

2. HDBASE-T/HDMI Extender Transmitter & Receiver- 100m Version

a. 100m HDMI extender shall deliver uncompressed HD video, 3D, and 2K x 4K over a single category cable with multi-channel audio supporting all standard formats including Dolby Digital, DTS, Dolby TrueHD, and DTS HD-Master Audio.
b. Resolution capability shall be 1080p 36 bit deep color at 60Hz with VESA resolutions up to 1920 x 1200 at 60Hz up to 100m (328 ft) and 4K ultra high definition up to 2160p 24 bit true color at 30Hz with 4K chroma subsampling color palette 4:2:2 up to 60m (197 ft).
c. Extenders shall include Ethernet channel capability with dual 100Mbps Ethernet ports.

3. HDBASE-T/HDMI Extender Transmitter & Receiver- 70m Version

a. 70m HDMI extender shall deliver uncompressed HD video, 3D, and 2K x 4K over a single category cable with multi-channel audio supporting all standard formats

including Dolby Digital, DTS, Dolby TrueHD, and DTS HD-Master Audio.
b. Resolution capability shall be 1080p 36 bit deep color at 60Hz with VESA resolutions up to 1920 x 1200 at 60Hz up to 70m (230 ft) and 4K ultra high definition up to 2160p 24 bit true color at 30Hz with 4K chroma subsampling color palette 4:2:2 up to 60m (197 ft).
c. The receiver shall be available separately for use with other HDBaseT certified devices

4. HDMI/VGA Autoswitching Extender Wallplate

a. Shall function as a user input device for source A/V equipment with HDMI or VGA/Audio outputs and forward those signals to appropriate display device(s) across an HDBase-T link.
b. Inputs shall include two (2) HDMI, one (1) VGA, and one (1) Analog Audio (for VGA) connections, output shall be one (1) RJ-45 (HDBaseT).
c. Inputs shall be automatically switched based on input presence sensing (or manually selected) to permit seamless transfer from one source to the next.
d. Shall include a "SOURCE/AUTO" button to select manual or auto source selection, and signal lights to indicate selected source and source activity.
e. Shall have a connection to allow external control via separate optional remote wallplate controller.
f. Shall be HDBaseT Alliance certified for compatibility with other compliant HDBase-T extension devices.
g. Shall be housed in a dual-gang Decora® form factor with matte anodized aluminum finish.
h. Shall deliver full uncompressed HD video in 3D, 2K, and 4K (VESA resolutions up to 1920 X 1200 at 60Hz, and HDTV resolutions up to 2160p) over single category cable up to 70 meters (230 feet).
i. Shall also support VGA resolution to 1920 X 1200.
j. Shall include a built-in scaling function to automatically match signals to 1080p display resolution.
k. Shall include Power over HDBaseT (PoH) capability, allowing powering from the receiver at the display end.
l. HDMI and VGA inputs shall include connector locking features.
m. Shall include an IR (Infrared) "target" and support IR repeating through the HDBaseT link to receiver at display end.
n. Shall be a maximum of 1.5” in depth to allow mounting in standard 4-inch or 4.675-inch square electrical box.

5. Remote Switching Multibutton Control Wallplate

a. Shall integrate with the Autoswitching Extender Wallplate to add an additional remote control location.
b. Shall have eight configurable buttons and fit in a dual-gang form factor.
c. Shall be all-metal construction and have a matte anodized aluminum finish.
d. Buttons shall be pre-configured for power on/off, volume up/down, HDMI 1, HDMI 2, VGA, and lock.
e. Setup shall be via IR learning and include a copy/paste function to expedite setup of multiple rooms for larger projects.
f. Installation shall not require additional computer hardware, Internet access, or software.
g. Shall include a key lock function to reduce inadvertent operation in the field.
h. Volume buttons shall operate by both single press and press/hold.

Approved Products:

Leviton Transmitter & Receiver set, 100m, 41910-THE
Leviton Transmitter & Receiver set, 70m, 41910-HT0
Receiver Only, 70m, 41910-HTR
Leviton HDMI® & VGA Autoswitching HDBaseT™ Extender Wallplate, 41920-HRC
Leviton 8-Button Control Panel, 41920-CP8

B. STANDARD AV EXTENSION DEVICES

1. HDMI Extender Transmitter & Receiver- 40meter version

   a. HDMI transmitter and receiver shall extend HDMI signal up to 40 meters over dual category-rated cables.
   b. Transmitter and Receiver shall support VESA resolutions up to 1920 X 1200 @ 60Hz, and HDTV resolutions up to 1080p over two category cables up to 40m (131 ft) and 720p/1080i (HDTV) up to 60m (197 ft).
   c. Transmitter and Receiver shall support Dolby True HD and DTS HD Master Audio, and be EDID, HDCP, and DDC compatible.
   d. Transmitter and Receiver shall include 8-position equalization adjustment for optimizing display quality over varying cable lengths
   e. Transmitter and Receiver shall include Power and On-Line LEDs to aid in setup
   f. Transmitter and Receiver shall include locking feature for HDMI connectors
   g. Separate TMDS and DDC ports shall be included to use a single category cable where HDCP and EDID bypass features are not required
   h. Transmitter and receiver shall be FCC Part 15; subpart B, Class A compliant
   i. AC power adapters shall be included for both Tx and Rx units.

Approved Products:
Leviton HDMI Transmitter & Receiver set 40m, 41910-H00

2. VGA Extender Transmitter and Receiver

   a. VGA Extender shall deliver screen resolutions of 1920 X 1200 @ 60Hz up to 30m (98 ft) and 1600 X 1200 up to 100m (328ft) over one Category cable.
   b. VGA Extender shall support mono audio transmission.
   c. VGA Extender shall provide adjustable gain for optimizing display quality over varying cable lengths.
   d. VGA Extender shall include power, and link LED indicators.
   e. VGA Extender shall support hot-plugging of source devices for instant video output.
   f. VGA Extender shall support mono audio transmission via 3.5 mm Audio input and output ports on devices.
   g. External power shall be required only at receiver
   h. Transmitter and receiver shall be FCC Part 15; subpart B, Class B compliant
   i. USB to power adapter cable shall be included for powering receiver from display USB port
   j. VGA cable shall be included for connection of receiver to display
   k. 3.5mm audio cable shall be included for connection of source device audio output to transmitter
   l. Transmitter shall include thumbscrews to connect directly to source without need for VGA cable. Extender transmitter and receiver shall have a metal enclosure and include mounting brackets for surface mounting.
   m. AC power adapters shall be included for both Tx and Rx units.

Approved Products:
Leviton VGA Extender Transmitter & Receiver, 41910-V01

3. USB 1.1 Extender Transmitter & Receiver

    a. USB Extender shall extend USB 1.1 signals from computer to device or hub up to 50 meters (164 ft) over a single category-rated cable.
    b. USB Extender shall comply with USB 1.1 specification.
    c. USB Extender shall support high-speed 12Mb/s and low-speed 1.5Mbp/s protocols.
    d. No external power shall be required.
    e. Transmitter shall include integral 0.3m (1ft) cable for flexible connection to computer port.
    f. Transmitter and Receiver interface housing shall be made of high impact plastic and be no larger than 2.56" L x 1.22" W x .85" H.
    g. Transmitter and receiver shall be FCC Part 15; subpart B, Class B compliant

Approved Products:
Leviton USB 1.1 Extender Transmitter & Receiver, 41910-U11

C. AUDIO AMPLIFICATION

1. Stereo Mixing Audio Amplifier

    a. Mixing Audio Amplifier shall include two stereo audio inputs, and one balanced microphone input.

    b. The amplifier shall offer three output modes: 2 X 20W stereo, 1 X 40W bridge mono, and 2 X 20W dual mono.
    c. Three switchable inputs: two stereo audio and one mic
    d. The amplifier shall include a Mic mixer function with independent control; Mic input shall support 48 V phantom power.
    e. The amplifier shall include a line-audio output jack with controllable volume, volume, bass, treble, and mute controls and auto output mute on no input.
    f. The amplifier shall have a 20Hz – 20KHz frequency response range
    g. The amplifier shall include LED indicators for power and control function feedback.
    h. The amplifier shall be controllable via front panel controls and through infrared remote and/or RS232 interfaces.
    i. The amplifier shall include a locking power supply connector
    j. The amplifier shall be surface mountable with dimensions not to exceed 3.43" L x 4.84" W x 1.49" H

Approved Products:
Leviton Stereo Mixing Audio Amplifier, 41920-A01

2. 70V Mixing Audio Amplifier

    a. Mixing Audio Amplifier shall include two stereo audio summed inputs (RCA and 3.5mm), one digital audio fiber input, and balanced microphone input.
    b. Selectable independently controlled mic input shall have a mixer function, priority muting, and support 48V phantom power
    c. The Amplifier shall support 40W mono output at constant 70V or 100V.
    d. The Amplifier shall be controllable via front panel controls with LED indicators and through infrared and RS232 interfaces with 16 ID code selections.
    e. The amplifier shall be fanless and shall include 24V power supply with locking connector and mounting brackets.
    f. The Amplifier shall include volume, bass, treble, and mute controls
    g. The amplifier shall have a frequency response range of 20Hz to 20KHz

Approved Products:
Leviton 70v Mixing Audio Amplifier, 41920-A70

D. CABLING

1. HDBaseT Cables

   a. Cabling channels supporting HDBaseT signals shall be TIA/ISO Category 6A/Class EA compliant, utilizing Shielded or Noise Cancelling Isolation Wrap (segmented shield) cable and appropriate termination components.
   b. The cabling channel shall comply with Power over HDBaseT™ (POH) applications up to 100 watts
   c. Utilize Cat6A UTP cable as described above in Horizontal Cabling section for HDBaseT and other AV connections in this Section.

2. HDBaseT Connectors

   a. Modular Connectors shall be 8P8C (RJ45) CAT6A UTP jacks as described above in Horizontal Cabling section.
   b. Connectors shall be die cast, Quickport (Keystone) footprint, and fit in any faceplate, biscuit block or ceiling/box mount provided for in this Specification.
   c. Connector module shall be UL 2043 Plenum Certified. Wiring shall be universal and will accommodate both T568A and T568B pair/pin assignments.
   d. Connector Module shall be supplied with interchangeable icons (voice, data, A/V, and blank, color coded to match the connector face) for easy identification and tracking of data, voice, or other functions and shall be available in 13 different colors.

3. HDMI Connectors

   a. HDMI pass-through connectors landing in faceplates shall fit surrounding connectors in the same Quickport keystone-style device plate.

4. HDBaseT Cords

   a. Category 6A Component rated Slimline Patch Cords as described above in Horizontal Cabling section shall be used for HDBaseT interconnections in the transition from HDMI or VGA into UTP cabling.

5. HDMI Cable Assemblies

   a. Cable shall be High-Speed HDMI with Ethernet and shall be HDMI certified.
   b. The cable shall be rated CL2 for in-wall installations, be cULus Listed to UL 1863 and CAN/CSA C22.2 No. 233-09.
   c. HDMI cables shall be manufactured with gold plated Type A male HDMI connectors with molded TPE connector outer body.
   d. HDMI cables shall be manufactured with 28ga conductors and have an outside diameter of no greater than 0.27”
   e. HDMI cables shall support Audio Return Channel.
   f. HDMI cables shall be available with optional universal locking kit for adapting to a wide range of HDMI connector overmold sizes. Locking kit shall include both M3X0.5 and 40-40UNC screws.

Approved Products:
Leviton QuickPort HDMI® pass-through connector, 40834-00W

Leviton High-Speed HDMI® Cables with Ethernet, 41900-0*E (* = 3, 6, 10 or 15 ft length)
HDMI cable lock kit, 41900-LKT

2.08 FRAMES, RACKS AND CABINETS

A. FLOOR-MOUNTED 4-POST RACKS

1. Open 19” 4-post frame with #12-24 tapped hole extruded aluminum mounting rails designed to provide nearly 360 degrees of accessibility and unrestricted air flow.

2. 84" (2133mm) 45RMU height with EIA/ECA-310-E universal 5/8" (16mm), 5/8" (16mm), 1/2" (13mm) hole pattern. Permanently stamped rack mount unit (RMU) markings and (100) #12-24 mounting screws included.

3. Depth adjustable in 1" (25.4mm) increments from 30" (762mm) to 36" (914mm) overall depth.

4. Load Rating: 2000 lb. (907kg) capacity, evenly distributed along rack height.

5. UL Listed to the UL60950 Standard - File No. E171936.

Approved Products:
B-Line Four-Post Adjustable-Depth Equipment Rack, Black, SB837084CFB
Chatsworth

B. FLOOR-MOUNTED 2-POST RACKS

1. Universal junction hole pattern matches most manufacturers racks. #12-24 panel mounting holes. Conformance to EIA/ECA-310-E and UL Listed (File No. E171936) as a communications circuit accessory.

2. Load Rating: 1200 Lbs. (544kg) weight capacity when evenly distributed for the height of the rack (84” (2133mm) and shorter).

3. Material: Aluminum. Twin top angles for rigidity.

4. Add (1) front/rear vertical wire manager on each side or between racks. See Wire Management, below.

5. Permanently stamped rack mount unit (RMU) markings included. Double sided universal (5/8" (16mm), 5/8" (16mm), 1/2" (13mm)) mounting spacing.

6. Includes thirty (30) dog point combo head (Phillips and flat blade) mounting screws.

7. Tapped assembly holes eliminate the need for nuts and simplifies assembly and squaring.

Approved Products:
B-Line 2-Post Network Relay rack, 19” x 7’ x 3” channel, 45RU, Black, SB506084XUFB

C. WALL-MOUNTED CABINETS

1. 19RU usable 36” tall, 30” depth, 24” wide, 19” hole pattern, locking Plexiglass door

2. Enclosure features fully welded, 16 gauge (1.5mm) cold rolled steel construction.

3. Mounts to wall as left hinged or right hinged opening with Heavy duty, field reversible hinge and lock system.

4. Rear section can easily be separated from the cabinet for simple installation onto a wall and rear sections feature removable plates with either multiple knockouts for conduit or bushing installation, or a high-density foam gland plate for ease of installing pre-terminated patch panels.

5. Gland Plate Kit shall be available to adapt cabinet to fit over existing installed or terminated cables, as needed.

6. Provisioned for 16" (406mm) on-center mounting and multiple wire management lances for cable tie points or accessory mounting. Provide one Vertical cable lacing bar for each wall mount cabinet

7. Fully adjustable EIA/ECA-310-E compliant mounting rail system with #12-24 tapped rails. UL listed to the UL60950

8. 36" (914mm) high cabinets rated for 200 lb (91kg) load; 48" (1219mm) high cabinets are rated for 300 lb (136kg) load. 36# cabinet is standard, use 48” as required.

Approved Products:
B-Line V-LINE WallMount cabinet, 36Hx30Dx24W, Black, VLWM3630PB
B-Line V-LINE Gland Plate Kit, Black, VLWMGPB
B-Line V-LINE Wallmount Cable Lacing Bar, Black, VLWMCLBB
B-Line V-LINE Wallmount 105 Cfm Fan Kit with Filter and Power Cord, VLWMFKB
B-Line V-LINE 90 Degree Vertical Equipment Mounting Bracket, VLWMSMBV90B
Chatsworth

D. VERTICAL WIRE MANAGERS

1. Provide full height, front-and-rear, 8” wide Vertical Wire Managers at the side of and between each 2-post and/or 4-post termination rack or frame. If space will not allow, the 5” wide wire manager may be substituted at row ends only, leaving the 8” vertical wire manager between each rack. Owner approval in writing is required prior to this substitution.

    a. The vertical cable management system shall be cULus listed, PCI rated for 94V-O, ABS rated for UL94HB, and compliant with ANSI/TIA/EIA 568-B standards.
    b. Mounting hardware shall be included to insure the proper installation to infrastructure. It shall mount onto a standard TIA/EIA recognized equipment rack.
    c. The management system shall offer an assortment of accessories, including a bend radius slack loop organizer, cable retainers, and shall accommodate top, bottom, side and pass-through cable routing. Dual hinged, cable concealing covers shall be included.

Approved Products:
Leviton Versi-Duct 8” Vertcal Cable Manager, 8980L-VFR
B-Line RCM+ Vertical Wire Manager, Black, SB86486D084FB
Chatsworth

E. HORIZONTAL WIRE MANAGERS

1. Provide 2RU duct-style horizontal wire managers above and below or between every 2RU of patch panel, as space allows.

    a. Cable managers shall be flat, covered duct style with front and rear channels.
    b. Do not coil or wind patch cords inside wire managers.
    c. Use recessed flat wire manager as needed within enclosed cabinets to route patch cords to opposite sides, where the rings of the flat wire managers would interfere with cabinet door closure.

Approved Products:
Leviton Versi-Duct Horizontal Wire Manager, 2RU, 492RU-HFR
B-Line V-Horizontal Wire Manager, Black, SB87019D2
Chatsworth

2.09 CABLE SUPPORTS

A. J-HOOKS

1. All cable shall be supported above ceiling on dedicated cable support hardware.

2. Cable saddles and J-hooks shall be used where cable tray or wire basket is not available. These must be supported on their own ceiling wires, threaded rod, or affixed to building structure by use of beam clamps (on metal beams) or wood screws (on wood beams). Affixing communication cable supports to existing ceiling support wires is not allowed.

Approved Products:
B-Line Cable Hook, BCHxx
B-Line Cable Hook, Cable to Beam Fastener, BCHxx-C2
B-Line Cable Hook, Cable to Fastener, 2”, BCHxx-C442
B-Line Cable Hook, Cable to Rod Fastener, 2”, BCHxx-W2
Chatsworth
Where:
xx = 21 (1.25”), 32 (2”), or 64 (4”)

B. CABLE TRAY

1. In Telecom Rooms, cable tray (ladder runway) shall be installed to support all cable running to racks and cabinets.

2. Cable tray to be added to all Telecom Rooms in places where cable is run horizontally.

3. Cable tray shall be aluminum, with 9” rung spacing. Rungs can be removed or repositioned to accommodate specific project or building requirements.

4. Cable shall be combed and bundled in all exposed runs outside walls, in TR/TE, and inside cabinets and wire managers.

5. All appropriate cable tray support hardware including angle brackets, rack-to-runway brackets, wall-to-runway brackets, elevation kits, junction splices, butt splices, and grounding jumpers shall be used for a complete and professional installation.

Approved Products:
B-Line Redi-Rail Runway, 12”, Black, SB13AL12FB
B-Line Wall-Mount Brackets, Black, SB211312FB
B-Line top mounting rack-to-rail plate, Black, SB213312FB

All other associated mounting hardware and metals from B-Line
Chatsworth

C. JACK/OUTLET BRACKETS

1. Above-ceiling cable termination locations shall be either wall-mounted or suspended from structure above the drop ceiling. Cables or terminations shall not rest on ceiling grid or equipment above ceiling grid.

2. For Wireless Access Points and other above-ceiling-mounted communications devices, cables shall land in an above-ceiling bracket which is affixed to dedicated cable support hardware.

3. Two category-rated jacks may be installed in each above-ceiling bracket. Each above-ceiling bracket will hold a 2-port Surface-Mount Box or 1-U MOS SMB for multimedia applications.

4. For wall-mounted device locations (above or below ceiling), devices needing to be mounted directly to a backbox will utilize the in-wall mounting bracket to secure the jack inside the backbox.

5. One category-rated jack can be installed in each in-wall backbox jack mounting bracket. For devices requiring (2) category-rated jacks, (2) in-wall brackets must be used.

Approved Products:
Leviton QuickPort In-Ceiling Bracket, rod/wire hanger, 49223-CBC
Leviton QuickPort In-Ceiling Bracket, accepts beam and screw mounts, 49223-CB0
Leviton QuickPort In-Wall Bracket, 49223-BA5 (pack of 5)

2.10 POWER DISTRIBUTION UNITS (PDU)

A. Provide (1) PDU per rack or wall cabinet. Unswitched, non-surge suppressed. 19” Horizontal for wall cabinets and 48” Vertical for floor-mounted cabinets.

B. Utilize plug and receptacle style appropriate for installation circuits and equipment interfaces.

Approved Products
Leviton Horizontal PDU, 19”, 20A P1000 series, L5-20P twist-lock plug, P1020-12S
Leviton Horizontal PDU, 19”, 15A P1000 series, 5-15P straight-blade plug, P1022-12L
Leviton Vertical PDU, 48” P1000 series, 5-20P straight-blade plug, P1043-10S
Leviton Vertical PDU, 48” P1000 series, L5-20P twist-lock plug, P1044-10L

2.11 FIRESTOPPING

A. Fire rated pathway devices shall be the preferred product and shall be installed in all locations where frequent cable moves, add-ons and changes will occur. Such devices shall:

1. Meet the hourly rating of the floor or wall penetrated.

2. Permit the allowable cable load to range from 0% to 100% visual fill thereby eliminating the need to calculate allowable fill ratios.

3. Permit multiple devices to be ganged together to increase overall cable capacity.

4. Allow for retrofit to install around existing cables.

5. Include an optional means to lengthen the device to facilitate installation in thicker barriers without degrading fire or smoke sealing properties or inhibiting ability of device to permit cable moves, add-ons, or changes

6. Not require any additional action on the part of the installer to open or close the pathway device or activate the internal smoke and fire seal, such as, but not limited to:

    a. Opening or closing of doors.
    b. Twisting an inner liner.
    c. Removal or replacement of any material such as sealant, caulk, putty, pillows, bags, foam plugs, foam blocks, or any other material.

7. Where single cables (up to 0.27 in. (7 mm) diameter) penetrate gypsum board/stud wall assemblies, a fire-rated cable grommet may be substituted. Acceptable products shall be molded from plenum-grade polymer and conform to the outer diameter of the cable forming a tight seal for fire and smoke. Additionally, acceptable products shall lock into the barrier to secure cable penetration.

Approved Products
Specified Technologies, Inc. EZ-PATH series 22, 33 and 44+ fire-rated pathway devices
Specified Technologies, Inc. EZ-PATH GROMMET
Hilti

B. Where non-mechanical products are utilized, provide products that upon curing do no re-emulsify, dissolve, leach, breakdown or otherwise deteriorate over time from exposure to atmospheric moisture, sweating pipes, ponding water or other forms of moisture characteristic during or after construction.

1. Where it is not practical to use a mechanical device, openings within floors and walls designed to accommodate telecommunications and data cabling shall be provided with re-enterable products that do not cure or dry.

2. Utilize an EMT sleeve as a stub through a rated wall

3. Surround annular space between EMT sleeve and wall material with a hardening intumescent caulk.

4. Utilize re-enterable, non-hardening putty around cables inside a metal sleeve. Do not exceed 40% fill capacity of sleeve and follow all rated assembly requirements per Manufacturer, local codes, and AHJ.

C. Cable trays shall terminate at each barrier and resume on the opposite side such that cables pass independently through fire-rated pathway devices. Cable tray shall be rigidly supported independent from fire-rated pathway devices on each side of barrier.

Approved Products
Specified Technologies, Inc. SSS Intumescent Caulk
Specified Technologies, Inc. SSP Intumescent Putty
Hilti

2.12 LABELING:

A. Cables

1. Horizontal and backbone cables shall be labeled at each end according to Owner

labeling standards (see below). The cable or its label shall be marked with its identifier.

2. Cable labels shall be machine-generated wrap-around labels with multiple cable ID's printed such that it can be viewable in place without turning the cable.

3. Label cables within 6" of termination point at both ends.

B. Faceplates

1. A unique location identifier shall be marked on each faceplate to identify its location in the cable plant.

2. Each port in the faceplate shall be labeled with its own unique identifier.

C. Racks, Panels, Blocks

1. A unique identifier shall be marked on each piece of connecting hardware to identify it as connecting hardware.

2. Each port on the connecting hardware shall be labeled with its own identifier to match the other end of the cable.

Approved Products

Brother Labelers and P-Touch. TZ Polyester labels.

Use clear tape with black lettering on ivory or stainless steel faceplates (3/8")
Use white (or clear) tape with black letters on white faceplates and surfaces (3/8")
Use black tape with white letters on black surfaces (as appropriate)
Use Flexible ID, white tape with black letters on cables (1"), with several lines of repeating cable ID's for any-angle viewing

PART 3 - EXECUTION

3.01 ADDITIONAL INFORMATION

A. Refer to Section 27 00 00 for the following Part 3 - Execution information

1. General
2. Cable Pathways
3. Work Area Outlets
4. Installation Practices
5. Labeling
6. Firestopping
7. Sealing of Penetrations and Openings
8. Cable Supports
9. Cable Protection
10. Grounding
11. Documentation
12. Training
13. Cleaning
14. Project Closeout

3.02 CABLE HANDLING / CABLE MANAGEMENT

A. Proper cable handling is critical to maintaining the design integrity of high-performance cabling. Cable handling recommendations include:

1. Cable must be conditioned above 32 degrees F for 48 hours prior to installation.

2. Do not use excessive force when pulling cable. The maximum pull-force guideline for a 4-pair horizontal UTP should not exceed 110N (25lbf). Meeting this guideline avoids stretching conductors during installation and the associated transmission degradation.

3. The minimum bend radius for UTP should not exceed 4 times the cable outside diameter (O.D.) The O.D. of Cat 6A 100 ohm, balanced UTP cable is .30 in. (4 x .3 = 1.2 in. bend radius).

4. The minimum bend radius for fiber should not exceed 10x the cable outside diameter.

5. Traditional bundling of Category 6 and 6A cabling for a combed appearance is required in all exposed locations.

6. In TR, use appropriate horizontal cable management for patch cords on front of patch panels. Also, use appropriate cable management bar(s) for support of terminated horizontal cable.

7. Do not use vinyl or plastic cable ties due to the potential for over-cinching of cable bundles which can alter the cable geometry and degrade the system cabling performance. Use only hook and loop (“Velcro”) fasteners for bundling of horizontal cables.

8. Store cable slack in an extended loop configuration to alleviate cable stress. Excessive cable slack in bundled loops or traditional ‘service loops’ to provide additional cable length in TR has been shown to degrade cabling performance and are not

recommended.

3.03 SEPARATION OF DATA AND POWER CABLING

A. Design cable pathways to avoid potential sources of EMI. Avoid installing cable near sources of EMI (X-ray equipment, large motors/generators, electrical power cabling and transformers, Radio frequency (RF) sources and transmitters, lighting, copiers, etc.).

B. Physically separate power & data cabling according to relevant code and standard requirements when run in a common pathway.

1. Never run data and Class 1 power cabling in parallel closer than 2".

2. Avoid crossing cables if possible. If necessary, always cross cables at 90 degrees.

3. Maintain a minimum of 5 in. separation between data cable and all ballast controlled lighting.

C. Minimum separation distances of telecommunications cabling from potential sources of EMI exceeding 5kVA:

1. 24" away from Unshielded power lines or electrical equipment in proximity to open or nonmetal pathways

2. 12" away from Unshielded power lines or electrical equipment in proximity to a grounded metal conduit pathway

3. 6" away from Power lines enclosed in a grounded metal conduit (or equivalent shielding) in proximity to a grounded metal conduit pathway

4. 47" away from Electrical motors and transformers

3.04 INSTALLATION OF STRUCTURED CABLING SYSTEM

A. PRE-INSTALLATION CONFERENCE

1. Schedule a conference a minimum of five calendar days prior to beginning work of this section.

2. Agenda: Clarify questions related to work to be performed, scheduling, coordination, etc.

3. Attendance: Communications system installer, General Contractor, Owners Representatives and any additional parties affected by work of this section. Owner's Information Technology must be represented at a preconference meeting prior to scheduling of any work.

4. Copy of Leviton warranty application will be provided by Contractor.

5. Pre-Installation conference may be waived only by Owner.

B. WARRANTY

1. A lifetime performance warranty covering all components, equipment and workmanship shall be submitted in writing with system documentation. The warranty period shall begin

on the system's first use by the Owner.

2. The project must be pre-registered with Leviton by the installation contractor before installation has begun, and shall be concluded by contractor with uploading of test results to Leviton and a full project closeout. Warranty paperwork will be delivered directly from Leviton to the Owner.

3. Should the cabling system fail to perform within its expected operation within this warranty period due to inferior or faulty material and/or workmanship, the Contractor shall promptly make all required corrections without cost to Owner.

C. DRAWINGS AND SPECIFICATIONS

1. The Contract drawings and specifications form an integral part of the contract documents. Neither the drawings nor the specifications shall be used alone. Drawings are generally diagrammatic and are intended to indicate the scope and general arrangement of work. Work omitted from the drawings but mentioned or reasonably implied in the specifications, or vice versa, shall be considered as properly and sufficiently specified and shall be provided. Misinterpretation of any requirements on drawings, or specifications shall not relieve the Contractor of his or her responsibility of properly completing the Contract.

2. The Owner's Project Manager has the option of changing the location of Electrical and Communication outlets to within 3 meters of designed location prior to rough-in stage at no extra cost to Owner. Owner and Owner's Representative requests a chalk/rough-in walk prior to installation to verify locations.

3. The Contractor is responsible to take field measurements where equipment and material dimensions are dependent upon building dimensions and to coordinate and provide a chalk/rough-in walk prior to installation to verify locations.

4. The Contractor shall coordinate with General, Mechanical and Electrical trades as well as Furniture Layout Designer for final workstation outlet locations.

5. Where conflict exists between drawings and specifications the Contractor shall, make allowance for provision of the component, system, or installation process in a manner which will provide the highest monetary cost components, systems, or installation process. Contractor shall inform the Owner's Project Managers of the conflict and obtain approvals prior taking corrective measures.

D. OWNER REQUIREMENTS AND STANDARDS.

1. A minimum of Four (4) CAT6A UTP cables and jacks (2 Data, 2 Voice) shall be installed in all standard work area outlet locations on a 6-outlet flush mounted faceplate, including offices, utility services, and other common telecommunications locations. Jack configurations will be Voice positioned at the top of the faceplate and Data is to be positioned at the bottom of the faceplate. The two center positions are to remain blank for future use.

2. All modular furniture will have a single workstation outlet per cubicle, unless specifically noted otherwise. All partition-wall or demising-walled areas have workstation outlets specifically noted on the Exhibit /Floor Plans.

3. Two (2) CAT6A UTP cables and jacks shall be installed at all Wireless Access Point locations. Security camera and AV / Multimedia locations also require CAT6A cables and jacks, but may require fewer or more cables. Refer to drawings for specific details.

4. Wallphone outlet locations require a single cable and jack on a stainless steel studded wallplate. Other locations may require more cables and jack outlets. Refer to drawings for specific details.

5. Data jack #1 shall be BLUE, Data jack #2 shall be BLUE. Voice jacks shall be IVORY. All termination wiring shall be T568B. – To be verified with owner prior to installation.

6. A minimum of 4 - 4 inch sleeves must be present in each IDF. Sleeves for penetration of walls and floors shall have a one hundred percent (100%) spare capacity and shall be fire-stopped as per code. Contractor is to provide additional sleeves if the rooms do not meet or exceed minimum requirements

E. PATHWAYS AND TOPOLOGY

1. Utilize “thin film” lubricants only! It has been shown that cable-pilling lubricants will affect your testing as the cable needs several weeks to dry before attenuation levels recover. Use of incorrect cable lubricants will erode cable jacket and void cable warranty.

2. All cable and wire shall be concealed in conduits, floor ducts, paneling, ceiling or similar areas except at mutually agreed upon areas.

3. Fill capacity in conduit, modular furniture and other horizontal pathways should not exceed 40%. A maximum of 60 % pathway fill is allowed to accommodate unplanned additions after initial installation. The Cat 6A cable is a larger O.D. (0.275” – 0.30” vs. .23” for typical for Cat6 cable). The increased diameter of Cat 6A cable will require appropriate design considerations when sizing conduit and other pathways. In most installations, conduit sizes will have to be increased in order to accommodate all of the cables being installed. This will impact the design and material selection of the project. To calculate the fill ratio, divide the sum of the cross-sectional area of all cables, by the most restricted cross-sectional area of the pathway.

4. Fill ratios for Augmented CAT6 cable (CAT6A) requires 1” EMT for 4 cables and sized larger for additional cables as required to maintain a 60% fill ratio.

5. Flat-rung and/or solid bottom cable tray shall be utilized for large, high-density installations. J-hooks and other specific cable support hardware shall be used at all locations outside of cable tray.

6. Pathway design should not exceed (2) 90 degree bends between pull points or pull boxes (PB). If more than (2) 90 degree bends are required, install a pull box between bends.

7. Provide NEC-sized pullboxes for any run greater than 100 feet, or with more than two ninety-degree bends.

8. J-hooks should be randomly spaced 60” or less. Do not exceed J-hook capacity for size and weight limitations.

9. Land wireless access cabling above ceiling, secured onto in-ceiling bracket. A slack loop in the horizontal cabling is not required. Utilize varying-length patch cords when installing wireless access point devices for flexibility in length.

10. Crimp-on plugs at wireless access points are not allowed. Terminate all WAP cabling onto jacks and ceiling-mount brackets and test all cables as appropriate.

11. Mixing of various Category cables in the same pathway is allowed as long as the applications are appropriate for each category of cable used.

12. Prior to placing any cable pathways or cable, the contractor shall survey the site to determine job conditions will not impose any obstructions that would interfere with the safe and satisfactory placement of the cables. The arrangements to remove any obstructions with the Project Manager need to be determined at that time.

13. Maintain a distance of at least 12 inches from all power conduits and cables, and 6 inches from all fluorescent lighting fixtures. Do not install power feeders 100 amps or greater above or within 5 feet of telecommunications backboard. Do not install telecommunications conduits above power panels or switchboards.

14. Cable shall be installed above fire-sprinkler systems and shall not be attached to the system or any ancillary equipment or hardware. The cable system and support hardware shall be installed so that it does not obscure any valves, fire alarm conduit, boxes, or other control devices.

15. The backbone subsystem shall include cable installed in a vertical manner between floor telecommunications room/closets (TCs or IDFs) and the main or intermediate cross-connect in a multi-story building and cable installed horizontally between telecommunications room/closets and the main or intermediate cross-connect in a long single story building.

16. Unless otherwise recommended by the Owner, all fiber cables will be encased in interlocking armor. All fibers will be terminated in the Telecom Rooms or Cabinets in rack-mounted enclosures equipped with sufficient ports to allow for growth, slack storage space and splice trays if required to terminate and secure all fibers.

17. Adequate riser sleeve/slot space shall be available with the ability to ingress the area at a later date in all Telecommunications rooms/closets, such that no drilling of additional sleeves/slots is necessary. Sleeves may need to be provided and installed under the scope of this Project.

18. The backbone cables shall be installed in a star topology, emanating from the main cross-connect to each telecommunications room/closet. An intermediate cross-connect may be present between the main cross-connect and the horizontal cross-connect.

19. For voice or data applications, 4 pair UTP or fiber optic cables shall be run using a star topology from the telecommunications room/closet serving that floor to every individual information outlet.

20. Backbone and Horizontal pathways shall be installed or selected such that the minimum bend radius is maintained both during and after installation.

21. All horizontal pathways shall be designed, installed and grounded to meet applicable local and national building and electrical codes.

22. Install ¾" x 4' x 8' fire-rated plywood across all walls in telecom rooms, from 6" AFF to 8'-6" AFF. Coat with 2 coats of white paint. Do not paint over fire rating stamp.

23. Contractor shall firestop all used pathways which enter or leave the telecom rooms via conduit, cable tray or slot. Contractor is responsible for installing sleeves at each wall or partition penetration, and firestopping all fire-rated penetrations. Intumescent caulk shall be applied around the outside of each sleeve, and intumescent putty inside the sleeve or conduits around the cables. Appropriate fill ratios must be followed when penetrating fire-rated walls.

24. Do not run fiber cables in conduits which are less than 2" in diameter.

25. Abandoned cable shall be removed from pathways (i.e., from tunnels, manholes, plenum spaces, and conduit) under scope of this project. Previously unknown or unidentified cable which is apparently abandoned prior to work shall be brought to the attention of the Owner for authorization prior to removal.

F. GROUNDING:

1. Refer to section 27 05 26 for specifications on Grounding and Bonding.

2. All grounding (earthing) and bonding shall be done to applicable codes, standards and regulations.

3. Shielded cabling channels shall include appropriate method of bonding shield to approved ground for proper EMI/RFI mitigation.

4. Shield Continuity Testing shall be Enabled when shielded cabling channels are installed.

5. All shielded and armored cables shall be bonded to a telecom grounding system via shielded patch panels at the rack locations. Shielded Category-rated connectors must be properly installed to maintain electrical ground conductivity along entire length of cable and at both ends of the cable. UTP connectors shall not be used on shielded cables at either end.

6. Shielded Patch cords shall be provided for use and employed at each workstation location utilizing shielded cable. Shielded patch cords can be identified by their gray color and metallic RJ45 plug. Shielded patch cords are not required at the patch panels.

7. Telecom Contractor shall bond and ground all telecom room metals. Telecom Contractor shall provide and install TIA-rated Telecommunications Grounding Busbar (TGB) at all MDF and IDF locations, and an in-cabinet grounding busbar at each remote wall-mounted cabinet or telecom enclosure. All ground lugs shall be 2-hole make-up.

8. Electrician will provide connection between TGB and building ground; Telecom contractor (if separate, otherwise electrician) will provide a busbar and ground all equipment and telecom metals to the busbar.

9. Telecom installer will ground and bond all armored and/or shielded cables, racks, cabinets, cable tray, ladder racking, and shielded panels to telecom grounding busbar.

G. CABLES AND TERMINATIONS:

1. Check plans and symbology for final determination of faceplate constitution or consult with Owner prior to bid.

2. Install additional cables at drop locations and in quantities indicated on the drawings. Do

not exceed manufacturers' recommendations for maximum allowable pulling tension, side wall pressure or minimum bending radius. Use pulling compound as recommended by cabling manufacturer.

3. All horizontal cables, regardless of media type, shall not exceed 90 m (295 ft) from the telecommunications outlets in the work area to the horizontal cross connect.

4. The combined length of jumpers, or patch cords and equipment cables in the telecommunications room/closet and the work area shall not exceed 10m (33 ft).

5. The Contractor shall observe the bending radius and pulling strength requirements of the 4 pair UTP and fiber optic cable during handling and installation.

6. No run of UTP cable between horizontal portions of the cross-connect in the telecommunication closet and the information outlet shall contain splices.

7. In a false ceiling environment, a minimum of 3 inches (75 mm) shall be observed between the cable supports and the false ceiling. Minimum 6" is preferred.

8. J-hooks shall be provided for all suspended cable, at a semi-irregular spacing not to exceed 5 feet between supports. Cables shall be supported by dedicated low-voltage cable support hardware. Support of cables or hanging hardware by means of supports or surfaces related to other trades or applications is not allowed.

9. Provide a full-size service loop (at least once around the inside edge of the box) in each J-box in the communications system.

10. Install all cable in plenum spaces with J-hooks of at least 1" in width to disperse the weight on the bottom cables. Homerun all cable to nearest TR Cabinet.

11. Comply with ANSI/TIA-569 for conduit and splice box sizing.

12. Install modular jacks at all outlets shown; one data jack for each data cable at each faceplate or termination point. Install additional cables and modular jacks as indicated on the drawings. Do not "split pairs" between different jacks.

13. Terminate cables at each jack location and at termination board or patch panel. Follow industry guidelines and manufacturers' recommendations and procedures as required. All termination hardware shall be rated to exceed their associated Category rating as specified above.

14. For enclosed ceiling WAP locations, install and terminate CAT6A cables to approximate location as shown on plans. For open-ceiling environments, secure cables and surface-mount boxes to nearest appropriate support structure.

15. For in-ceiling WAP locations, secure jacks inside a surface-mount block mounted to in-ceiling metal assembly, and provide a 5' patch cord or longer, as needed, to connect device to its final determined location in ceiling.

16. For wall-mounted device locations, utilize an in-wall bracket in lieu of faceplate as described above. Secure mounting bracket and device hardware directly over backbox. Connect device with 1' CAT6A cord (Security, AV, or WAP), or 1' high-flex CAT6 patch cord for other CAT6-based devices. Coil patch cord inside backbox.

17. Label and identify each outlet and cable for data circuits. Label at outlet end and at termination board or patch panel with matching designations.

18. Provide data outlets in surface raceway at 26" on center unless otherwise indicated.

19. Extreme care must be taken not to nick any of the copper conductors when removing jacket. Use rip cord to expose pairs for termination onto Insulation Displacement Contacts. You can also use a precision stripper that allows the technician to set the depth of the blade.

20. Maintain twists as close as possible to the point of termination. Untwisting of copper pairs should not exceed ¼" to the termination point.

21. Manage the cable bundles in a symmetrical orientation. For example, in a 48-port patch panel, distribute 24 cables through the vertical cable management on the left rear side of the rack and 24 cables through the vertical cable management on the right rear side of the rack.

22. Do not dress cables in bundles larger than 24 cables. Multiple 24-cable bundles may be run in parallel with evenly-spaced Velcro cable ties in an orderly sequence.

23. For cable management on rear of patch panel, cable shall sweep into termination points and be supported by appropriate rear cable management.

24. Horizontal patch cord management is required on all installations which do not use angled patch panels.

25. Maintain cable bend radius 4X outer diameter (UTP only) when mounting faceplate onto EMT backbox, box-eliminators or furniture knock-outs.

26. Faceplates and SMBs shall be fully installed and labeled prior to testing.

G. ABOVE-CEILING AND WALL-MOUNTED WIRELESS ACCESS POINTS AND DEVICES

1. All WAP locations shall receive (2) Category 6A cables from the nearest TE or TR (IDF). Multimedia, security and other video devices shall receive CAT6A cables as shown on drawings, documents and details.

2. Clock/Speakers and other low-bandwidth mounted devices shall receive (1) CAT6A cable.

3. WAP and other communications cables shall terminate on patch panels in the TE/TR (IDF).

4. WAP cables shall terminate on Category 6A information outlets and shall be supported by an in-ceiling termination bracket. Affixing of a 2-port SMB to the bracket is recommended.

5. SMB, jacks, and patch cords used in plenum spaces shall be plenum-rated.

6. SMB shall be mounted in the ceiling on a specially-designed clip attached to a cable support ceiling wire or threaded rod support per cable management section in Part 2. SMB shall not be tie wrapped to supports, or left on ceiling tiles or other equipment located above the ceiling.

7. Wall-mounted devices not requiring faceplates will be mounted directly to the backbox. Jacks will be secured inside backbox on a specially-designed in-wall bracket clip per cable management section in Part 2.

8. Contractor shall mount Access Point (AP) electronics to the drop-ceiling suspended T-grid system. (AP and mounting hardware provided by Owner). Contractor to provide and install (2) white Cat 6A patch cords from the overhead WAP outlets to the AP. Contractor shall neatly cut holes into the ceiling tile and finish the holes with grommets or other industry-standard finishing piece for a professional look.

H. AUDIO-VISUAL DEVICES

1. HDBASE-T DEVICES

   a. Follow manufacturer's user's manual for proper installation.
   b. One DC 24V power adaptor is required and can be attached at either end as the other can be energized via the PoH function of the interconnecting twisted pair cable.
   c. For best performance, Category 6A (isolation wrap or shielded) twisted pair cable should be installed in accordance with applicable ANSI/TIA-568 standards and be field certified to 500 MHz using approved testers.
   d. Properly secure HDMI cables to devices with lock kit brackets and tie wraps.
   e. Installation methods shall adhere to NFPA National Electrical Code and all local building and fire codes.

2. STANDARD AV EXTENSION DEVICES

   a. Follow manufacturer's instruction sheet for proper installation and adjustment.
   b. For best performance, Category rated twisted pair cable should be installed in accordance with applicable ANSI/TIA-568 standards and be field certified using approved testers.
   c. Install DC power adaptor(s) as required.
   d. Properly secure all cables with appropriate strain relief methods.
   e. Installation methods shall adhere to NFPA National Electrical Code and all local building and fire codes.

3. MIXING AUDIO AMPLIFIERS

   a. Follow manufacturer's instruction sheet for proper installation and sound level adjustment.
   b. Install DC power adaptor(s) as required.
   c. Properly secure all cables with appropriate strain relief methods.
   d. Installation methods shall adhere to NFPA National Electrical Code and all local building and fire codes.

4. HDMI CABLES

   a. Follow manufacturer's instruction sheet for proper installation
   b. Secure HDMI cables to active device ports with cable locking kits or industry best practice to mitigate inadvertent cable disconnects.

5. HDBASET CABLING CHANNELS

   a. 100 percent of cabling channels shall be tested to meet or exceed ISO/IEC Class EA performance parameters.

b. Cabling shall be installed in accordance with manufacturer's recommendations and best industry practices as well as compliance with all applicable sections of this Specification regarding Category-rated structured cabling.
c. When cables are being installed, slack (service loops) shall be provided at both ends to accommodate future changes in the structured cabling system.

I. FURNITURE CABLING

1. The contractor will pull all voice and data cables in advance of the installation of the modular furniture workstations, and coil at basefeed or above ceiling for power pole feeds. Upon furniture arrival, the contractor will feed the cables through power poles or base feed/wall connected data/telecom conduit, and terminate as specified on the floor plans.

2. Contractor to coordinate with Owner’s furniture vendor for timing of the installation of systems furniture, and installation of electrical and voice/data cabling. Overtime may be required for this and other phases of the project work, and bids, plans and schedules must reflect actual work demands. Contractor shall consider all costs in their bids for installation.

J. TERMINAL BLOCKS AND PATCH PANELS:

1. Arrange all terminal blocks in a manner that allows natural wiring progression and minimizes crossing of wires.

2. Dress and comb all incoming cable bundles in groups of 24 cables each. Eliminate crossed cables and “divers”.

3. Ground all shielded patch panels to telecom ground source via paint-piercing washers to a grounded rack, or via direct ground wire to telecom bus bar.

K. IDF ROOMS

1. The Data and Telco Rooms are a transition point between the backbone and horizontal distribution pathways. The rooms shall be able to contain data or telecommunications’ equipment, cable terminations and associated cross-connection wiring. Closet spaces are not to be shared with electrical installations, other than those directly for telecommunications, video, security and information systems equipment. The rooms are not to be shared with other unrelated building service, for example plumbing. Any conflicts with these specifications require the approval of the Owner’s project manager.

2. Contractor shall submit a drawing of the IDF room showing layout of all components including necessary and required electrical outlets, conduits, environmental requirements and wire termination fields prior to start of the job. Any jack densities noted in these specifications are estimates only. The drawing will designate the most effective, scalable, jack termination cabling design to facilitate data/telecom outlets shown on the lease exhibits. Owner’s Project Managers must approve drawings prior to installation.

3. All racks, panels, and equipment finished shall be anchored to meet local seismic zone requirements and industry standards. The equipment racks are to be anchored to the concrete floors via “Unistrut or equal metal framing strut systems”, threaded rod, concrete anchors, bolts and washers.

4. The overhead cable ladder system will provide a route for the Category 6 and 6A, and

other communication cables while providing stability to the equipment racks.

5. The vendor is responsible to provide and install the specified count of 19" EIA rack-mount 7' (45U) 2- post racks, Black, as required in the new IDF. The vendor is responsible for submitting IDF layout drawings to Owner for approval prior to installation.

6. The contractor shall provide high capacity horizontal and vertical cable manager channels are required in all data and equipment racks, and the racks will contain sufficient vertical and horizontal cable managers to facilitate the patch panel density and placement installed by the contractor.

7. Contractor will install raceways, boxes, managers, and enclosures as indicated according to manufacturer's written instructions. Securely fasten each component to the surface to which it is mounted and remove burs and sharp edges from all cable tray.

8. A 12" ladder rack system is required and will be provided by the contractor and installed in the IDF to provide cable support to the rack system. This includes all of the required ladder rack support items such as rack to runway kits, wall angle brackets, ceiling supports, splices (junction and butt), radius drops and j-bolts. The final ladder rack layout will be included in the IDF layout drawing described above.

9. Provide and install as needed in the IDF room 4' x 8" x 3/4" fire-rated plywood board and labeled with fire rating stamp facing into the room to accommodate rack ladder support, cabling support, grounding platform, data and voice equipment. Paint backboard white (leave stamp visible) to match existing backboard in room, if appropriate. Location of installation is to be determined with approval by Owner.

L. PATCH CORDS:

1. Contractor to provide and install fiber and copper patch cords in quantities as described below. Neatly install patch cords in lengths as appropriate to reduce unnecessary length in wire managers.

2. Install patch cords at the equipment cabinet between patch panel and owner-provided switches for each patch panel and workstation location. Patch cords shall direct-connect between patch panel and networking switch or other electronics equipment. Dress and bundle patch cords as appropriate for final installation. Provide any unused equipment patch cables to Owner in original packaging upon completion of project.

3. Install Wireless Access Point patch cords as described above, and other field-installed networkable device via a vendor-supplied patch cord at the remote locations. Return unused patch cords to Owner in original packaging.

4. Provide workstation patch cords to Owner in original packaging.

5. Use the following guidelines for project bid. Verify all lengths with Owner prior to purchase:

    a. Provide and install one (1) 7-foot patch cord, of the same category rating, for each cable terminated at the patch panel
    b. Provide one (1) 10-foot patch cord, of the same category rating, for each cable terminated at the terminal outlet location
    c. Provide one (1) 2-meter patch cord, of the same grade of fiber, for each LC connector pair installed at the IDF, MDF, and all other terminal enclosure locations.

6. All fiber patch cords and required workstation/equipment patch cords not installed shall be provided in hand to Owners Representative prior to project closeout.

M. LABELING

1. Provide machine-generated labels appropriate for all components supplied and installed. Under no circumstances shall hand written labels be used.

2. Each faceplate, cable, or data outlet (drop) will be numbered with a unique identifier clearly indicating the voice and data jacks by floor number, station, and outlet identification. This labeling scheme will be independent of any assigned telephone numbers.

3. The labeling scheme shall not include duplicates of any new or existing cable identification across the entire cable plant.

4. Labeling procedure will meet TIA-568, TIA-606 (Class 2 Administration) and BICSI Standards.

5. The labeling scheme will be provided at all locations within the cable infrastructure:

6. Labeling will be as follows:

   a. The numbering scheme will be Floor Number, Jack Number.1 or .2. (7.###.1 and 7.###.2)
   b. Label patch panel RJ-45 jacks numbered sequentially with 2 data jacks per station in line, designated by".1" and ".2".
   c. Label Wireless Access Point cabling as AP01.1 / AP01.2, AP02.1/AP02.2, etc.
   d. Label Racks containing patch panels as "DATA" and "VOICE".

3.05 VERIFICATION OF IDF ENVIRONMENT

A. All inspections which expose existing conditions not meeting Owner standards as described above must be reported to the Owner prior to installation. Owner may require additional work to bring existing site conditions up to Standard. Areas to explore shall include, but not be limited, to the following items.

B. Insufficient or failed HVAC flow in the IDF with the appropriate exhaust system. Air temperatures shall not exceed 78 degrees sustained.

C. It is recommended to recess any existing or new fire sprinklers in the IDF to prevent accidental damage and associated risks.

D. Lighting layout fixture pattern is to provide sufficient lighting over front and back of each equipment rack.

E. In the IDF room, a minimum of (2) 20-amp, dedicated, duplex power outlets box must be provided to support network electronics. Outlet boxes must be installed on the top of the equipment rack in a location approved by Owner and the Network Support (IT) representative.

F. All existing racks, cable tray, and metal structures shall be appropriately anchored and bonded to telecom ground and in sufficient size, quantity and configuration according to Owners standards as described above.

G. Any penetration of fire and smoke barrier must be approved by the Lessor and/or Owner. Such penetrations must be properly treated according to industry standards, all applicable codes and with the current addition of the National Electrical Code. Minimally, metallic sleeves patched-in with fireseal putty, and filled with pliable intumescent materials meeting the applicable codes shall be used. In all cases, the Contractor shall be responsible for compliance with all federal, state and local regulations in effect.

H. During installation, any penetration of fire wall shall be sealed with approved firestop material by the end of each working day; that is, fire walls shall not be left with a vulnerable point overnight.

3.06 TESTING

A. COPPER TESTING

1. Test all equipment and each outlet, horizontal cable, termination block, patch cords, etc. to verify compliance with requirements. Testing shall consist of attenuation and NEXT across all splices and devices installed in the field and shall meet latest requirements of EIA/TIA. Re-terminate any cable or connection found to be defective.

2. Tester is to be a Level IV device or better, and configured with the specific cable installed, and the Permanent Link test will be performed according to the Category's standard methodology. All parameters must exhibit a PASS test result prior to project completion. PASS*, FAIL* or FAIL test results will not be accepted.

3. Only a permanent link test for Category 6A will be required. If situations demand a "hybrid", "Mixed" or a standard "Channel" design, approval must be obtained for those specific circumstances prior to testing.

B. FIBER OPTIC TESTING

1. Each pre-terminated fiber strand shall be tested for continuity and attenuation with an Optical Power Meter and light source for actual length and splice/connector loss. Each field-terminated fiber strand (if any) shall be tested for attenuation with an Optical Power Meter and light source and with an Optical Time Domain Reflectometer (OTDR) for actual length and splice/connector loss.

2. Cable length shall be verified using sheath markings. The guidelines and procedures established for Tier 1 testing in TIA/TSB-140 shall apply.

3. All fiber optic cables shall be tested from the site's MDF to each fiber terminals located in the IDF.

4. The Contractor shall conduct a bi-directional power meter (loss) test of each fiber optic station and riser cable at both wavelengths, 850/1300nm for MM and 1310/1550nm for SM.

5. No individual station or riser fiber link segment (including connectors) shall measure more than 2.0 dB loss for LC, and 1.5dB loss for MTP. LC links shall be tested with LC jumpers from the LC cassette to the tester. MTP links shall be tested either with an MTP tester and array cord, or with an MTP-LC breakout harness and LC duplex fiber tester.

6. Tests shall be conducted using ANSI/TIA-526-14A, Method B. Test results evaluation for the panel to panel (backbone) shall be based on the values set forth in ANSI/TIA-568.

7. The Contractor shall provide an electronic printout for each strand tested with the Power Meter and the OTDR.

8. Where concatenated links are installed to complete a circuit between devices, the Contractor shall test each link from end to end to ensure the performance of the system. After the link performance test has been successfully completed, each link shall be concatenated and tested. The test method shall be the same used for the test described above. The evaluation criteria shall be established between the Owner and the Contractor prior to the start of the test.

9. All installed cables must meet or exceed the defined standards for performance. The Contractor shall take all steps and all expense necessary to clean, repair or replace any optic link not meeting the standard.

C. TEST RESULTS

1. Repair and resolve any shortcomings in the test results. Mitigation efforts may require re-termination or replacement of the jack, outlet or cable. Repairs or attempts to resolve test failures will be completed solely at the expense of the Contractor.

2. Provide test results to Manufacturer and Owner representative in native Tester format. Upon request, provide a copy of the tester software and license, if needed, at no charge to Owner representative.

3. Include PDF of full test results, summary index in electronic format on CD or memory stick in the O&M package upon project completion.

4. Cabling systems shall meet or exceed the electrical and transmission characteristics of the systems specified.

5. Cable segments and links shall be tested from both ends of the cable for each of the construction phases. (Verify that cable labeling matches at both ends).

6. The system shall not be considered certified until the tester has acknowledged that the performance of the physical layer of the system has been fully tested and is operational at the completion of the installation phase.

7. After the installation is complete, in addition to any other required testing as described herein, and at such times as the Owner/Engineer directs, the Contractor shall be present while the Owner conducts an operating test for approval. The installation shall be demonstrated to be in accordance with the requirements of this specification. Any defects revealed shall be corrected promptly at the Contractor's expense and the tests performed again.

8. After review of the completed test results, the Owner reserves the right to retest cables, utilizing the Contractor's tester and the Contractor's labor.

9. The test results information for each link shall be recorded in the memory of the field tester upon completion of the test. The tester shall be capable of storing test data in either internal or external memory. The external media used shall be left to the discretion of the user.

10. Test results saved by the tester shall be transferred into a Windows based database utility that allows for maintenance, inspection and archiving of these test records. A

guarantee must be made that the measurement results are transferred to the PC unaltered as well as any printed reports generated from the software application.

11. Test results shall be provided in both native Tester format as well as comma separated variable (.csv), Portable Document File (.pdf), plain text (.txt), or hypertext markup language (.html/.htm). A copy of the tester native test software must be provided to Owner or Owner's representative for comparison of results.

12. Test Results for CAT6 shall include the following:

    a. Applicable room number of jack location (room number per Contract Documents)
    b. Applicable Telecommunications Room number
    c. Circuit I.D. number with corresponding jack identifier
    d. Wire Map – shall include the following:
        i. Continuity to the remote end
        ii. Shorts between any two or more conductors
        iii. Crossed pairs
        iv. Reversed pairs
        v. Split pairs
        vi. Any other mis-wiring
    e. Length
    f. Insertion Loss
    g. Near-end Crosstalk (NEXT) Loss
    h. PS-NEXT (Power Sum Near End Cross Talk)
    i. FEXT (Far End Crosstalk)
    j. ELFEXT (Equal Level Far End Cross Talk)
    k. PS-ELFEXT (Power Sum Equal Level Far End Cross Talk)
    l. Propagation Delay
    m. Delay Skew
    n. Return loss
    o. PSFEXT (Power Sum Far End Crosstalk)
    p. PSACRF (Power Sum Attenuation to Crosstalk Ratio, Far End)

13. Test Results for CAT6A shall include all of the above, plus the following:

    a. AACRF (Alien Attenuation to Crosstalk Ratio, Far End)
    b. AFEXT (Alien Far End Crosstalk)
    c. ANEXT (Alien Near End Crosstalk)
    d. PSANEXT (Power Sum Alien Near End Crosstalk)
    e. PSAACRF (Power Sum Alien Attenuation to Crosstalk Ratio, Far End)

Approved Tester Products:
Softing WireXpert series tester
Fluke DTX or later platform Cable Certification testers
Linkware Record Management Software

3.06 PROJECT CLOSEOUT

A. Operating and maintenance manuals shall be submitted prior to testing of the system. A total of (3) manuals shall be delivered to the Owner. Manuals shall include all service, installation, and programming information.

B. Provide a full set of "as-built" (redline) drawings in AutoCAD DWG and PDF format. Drawings to depict final location and drop/cable identification numbers and labels which match the test reports. Include (1) hard copy paper format of all as-builts in 30"x42" size or equivalent,

posted in each telecom room involved in the project.

C. Contractor to provide all warranty information to Leviton for processing. Leviton will send warranty document direct to Owner.

3.07 TRAINING

A. Provide four (4) hours training on the operation and installation of the data system, at job site, at no cost to owner.

END OF SECTION

SECTION 28 1000
INTERCOM SYSTEM

Aiphone Corporation

PART 1 – GENERAL

1.01 Common Work

A. Furnish and install “Aiphone IS Intercom System” with components.

PART 2 - PRODUCTS

Qty	Model	Description	Literature
9	IS-IPDVF	IP Video Door Station, Flush Mount Stainless Steel	Specifications Instructions
1	IS-IPMV	IP Video Master Station, Wall or Desk Mount	Specifications Instructions
2	IS-SOFT	PC Master Station Software	Instructions
10	PS-2420UL	24V DC Power Supply, 2A, UL Listed	Instructions

Notes:
1. Network devices required to connect an IS network system are not included in this specification and must be purchased separately. Not available from Aiphone. 2. To ensure proper operation of the system, the network used to connect the IS Networked system must support **IGMP v2 for multicasts.** For additional information contact your network administrator or Aiphone Technical support at (800) 692-0200. 3. Be sure to register your IS-SOFT after installation. It's the only way to retrieve the activation code should it be lost! 4. All Network direct units except the IS-IPC can be powered using a POE network. If you will be using POE please subtract the appropriate number of PS-2420UL's from this equipment list. 5. Programmable dry contacts are available at the door station. The contacts are form C 500mA, 24V AC/DC. Door release wiring from the door station is separate from the network connection to the door station. 6. Door strikes and their power sources are not included in this quote and must be purchased separately. Not available from Aiphone.

Aiphone Wire

System	Wire #	Description	Max. Distance	Jacket/ Nom. O.D.	Capacitance/ Loop Res.
Power to units	821802	2 Cond.,18AWG, Shielded Available in: 1000’	N/A	PVC .185 "	55 pf/ft 6.45Ohms
Contact to Strike	821802	2 Cond.,18AWG, Shielded Available in: 1000’	N/A	PVC .185 "	55 pf/ft 6.45Ohms

PART 3 – EXECUTION

3.01 Installation

A. Furnish and install all system components as shown on drawings.
B. Provide wiring, backboxes, etc. for complete system installation.
C. Provide all required connections for system operation.
D. Provide training to Owner’s Representatives after system installation and verification of operation.
E. Provide Owner’s Manual to Owner’s Representative.

END OF SECTION

SECTION 28 1300

ACCESS CONTROL

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. This Section includes an IP based security access control system (ACS) consisting of either a ACS Host Server or Cloud Host Service, client workstations utilizing any supported web browser and field-installed IP based Reader-Controllers and/or IPBridges connected by a high-speed electronic data transmission network. This system's features include regulating access through controlled openings, credential management, monitoring of field devices, and reporting.

B. Related Sections:

1. 14 28 16 – Elevator Controls
2. 28 16 33.16 – Intrusion Detection Interfaces to Access Control Hardware
3. 28 16 43 – Perimeter Security Systems

1.03 REFERENCES

A. Abbreviations and Acronyms

1. ACS – Access Control System
2. AES – Advanced Encryption Standard
3. I/O – Input/Output
4. ISAM – Indexed Sequential Access Method
5. LAN – Local area network.
6. LED – Light-emitting diode
7. PC – Personal Computer
8. RFID – Radio Frequency Identification
9. TCP/IP – Transport Control Protocol/Internet Protocol
10. UPS – Uninterruptible power supply.
11. WAN – Wide area network

B. Definitions

1. ACS Cloud Service – A cloud based service hosted and maintained by the Manufacturer for administrating and communicating to Reader Controllers and IPBridges.
2. ACS Host Server - A Windows Server with software designated for providing a web based interface to administrate and communicate to Reader Controllers and IPBridges.
3. ACS Host – Either the Cloud Service or Host Server listed above.
4. IP based Reader-Controller - An intelligent network-connected reader controller unit with inputs, outputs and data storage capability.
5. IPBridge – An intelligent interface to legacy based access control systems using traditional structured cabling and proximity readers.
6. Access Point – Any Reader Controller or port on an IPBridge connected to the ACS Host.

7. Credential - RFID based token assigned to an entity and used to identify that entity.
8. Mobile Credential – Token using Bluetooth® Low Energy on any Android or Apple device
9. Identifier - A credential card, keypad personal identification number or code, or other unique identification entered as data into the entry-control database for the purpose of identifying an individual. Where this term is presented with an initial capital letter, this definition applies.
10. RFID - An automatic identification method, relying on storing and remotely retrieving data using devices called RFID tags or transponders.
11. Client - Any device with a supported web browser that can connect to either the Cloud Service or Host Server.

C. Reference Standards

1. SIA BIO-01-1993.02(R2000.06) - Biometric Standard - Vocabulary for Testing
2. Institute of Electronic and Electrical Engineers (IEEE) 802.3 standards
3. Underwriters Laboratories

    a. UL 294 - Access Control System Units
    b. UL 294B - Power Over Ethernet

4. FCC 47, CFR Part 15
5. Industry Canada - Radio Standards Specification RSS-210 License-exempt Radio Apparatus
6. National Institute of Standards and Technology (NIST)

    a. FIPS 197 - Advanced Encryption Standard (AES)

7. ISO 14443A, 14443B - Proximity Cards
8. EIA/TIA-569 - Commercial Building Standard for Telecommunications Pathways and Spaces
9. ETSI EN300, EN330-2, EN301 489-1

1.04 SUBMITTALS

A. General:

1. Submit in accordance with Conditions of Contract and Division 01 requirements.
2. Highlight, encircle, or otherwise specifically identify on submittals deviations from Contract Documents, issues of incompatibility or other issues which may detrimentally affect the Work.
3. Prior to forwarding submittal, comply with procedures for verifying existing door and frame compatibility for new hardware, as specified in PART 3, “EXAMINATION” article, herein.

B. Action Submittals

1. Product Data

    a. Manufacturers’ printed and electronic data sheets, including operating characteristics, furnished specialties, and accessories.
    b. References for each product to a location on Drawings.
    c. Test and evaluation data presented in compliance with SIA BIO-01
    d. Manufacturers’ installation and operation manuals

C. Closeout Submittals

1. Field quality-control test reports

2. End User Training Plan
3. Operation and Maintenance Data

    a. Microsoft Windows software documentation.
    b. For each PC, installation and operating documentation, manuals, and software for the PC and all installed peripherals.
        1) Include system restore, emergency boot diskettes, and drivers for all installed hardware.
        2) The software manual shall describe the functions of all software and shall include all other information necessary to enable proper programming and operation. The manual shall fully explain all procedures and instructions for the operation of the system.

    c. System installation and setup guides.

4. List of recommended spare parts.

1.05 QUALITY ASSURANCE

A. Electrified Door Hardware: Listed and labeled as defined in NFPA 70, Article 100, by testing agency acceptable to authorities having jurisdiction.

B. Coordination Conferences:

1. Electrified Hardware Coordination Conference: Prior to ordering electrified hardware, schedule and hold meeting to coordinate door hardware with security, electrical, doors and frames, and other related suppliers.

C. Supplier Qualifications:

1. Manufacturer shall have a minimum of ten years' experience in manufacturing access control equipment and possess current New Mexico ES-3, ES-7 licenses with a service organization within 125 miles of the installation.
2. Installers shall have been trained, certified, and approved by the Manufacturer.
3. Personnel knowledgeable in local, state, province and national codes, and regulations. All work shall comply with the latest revision of the codes or regulations. When conflict exists between local or national codes or regulations, the most stringent codes or regulations shall be followed.
4. Installing company to be Native American and Veteran owned.

1.06 DELIVERY, STORAGE, AND HANDLING

A. ACS Host Workstation and Supporting Workstations:

1. Store in temperature- and humidity-controlled environment in original manufacturer's sealed containers. Maintain ambient temperature between 50 and 85 deg F (10 and 30 deg C), and not more than 80 percent relative humidity, non-condensing.
2. Open each container; verify contents against packing list, and file copy of packing list, complete with container identification for inclusion in operation and maintenance data.
3. Mark packing list with designations that have been assigned to materials and equipment.

B. IP Bridges and IP-based Reader-Controllers:

1. Store in temperature and humidity-controlled environment in original manufacturer's sealed containers. Maintain ambient temperature between -40 and 120 deg F (-40 and 50 deg C).

2. Open each container; verify contents against packing list, and file copy of packing list, complete with container identification for inclusion in operation and maintenance data.
3. Mark packing list with designations that have been assigned to materials and equipment.

1.07 COORDINATION

A. Security: Coordinate installation of door hardware, keying, and access control with Owner's security consultant.

B. Electrical System Roughing-In: Coordinate layout and installation of electrified door hardware with connections to power supplies and building safety and security systems.

1.08 WARRANTY

A. Manufacturer shall provide a limited one year hardware warranty for the product to be free of defects in material and workmanship.

B. Manufacturer shall provide software updates for cloud service as they are available and will be automatically granted. On premise software updates are available through a software upgrade program.

C. Manufacturer shall make available an extended warranty and maintenance support option.

PART 2 - PRODUCTS

2.01 EQUIPMENT

A. Manufacturer: ISONAS

B. Models:
1. Software: Either Pure Access™ Cloud or Pure Access™ Manager
2. Hardware: Pure IP Reader Controller and/or Powernet IPBridge
3. Badge Printer: DataCard SDXXX

C. Acceptable Manufacturers: No Substitution.

2.02 DESCRIPTION

D. The system shall consist of a ACS Host; either Cloud Service or a local Server Host, one or more client workstations, IP based Reader-Controllers and/or IPBridges connected by a high-speed electronic data transmission network.

1. The Cloud Service shall be host on Amazon Web Services and provide for a minimum of 99.95% uptime. The Manufacturer shall closely monitor all conditions related to the Cloud Service infrastructure.

E. The network connecting the ACS Host, Client Workstation(s), IP Bridge and IP based Reader-Controllers shall be a Local Area Network (LAN) or Wide Area Network (WAN) utilizing TCP/IP communications protocol and having the capacity of connecting an unlimited number of devices and workstations

F. Functions - The systems primary functions shall include

1. Regulating access through doors, gates, turnstiles, and other entrance portals
2. Credential cards and readers
3. Credential creation and credential holder database and management

4. Monitoring of field-installed devices
5. Reporting

G. Third Party Devices - In addition to supporting the Manufacturer's own multi-card readers, the system shall support the following types of readers:

1. Wiegand output devices including but not limited to:

a. Biometric devices
b. Long Range Readers such as Tagmaster
c. Barcode scanners

2.03 SYSTEM SOFTWARE

A. The ACS Host application software shall provide the interface between the Client, IPBridges, IP based Reader-Controllers, report alarms, generate reports and provide all other system functions.

B. The system shall provide a web based User Interface using standard browsers such as Chrome, Firefox and Microsoft Edge. Mobile devices such as tablets and smart phones will be able to log in via the same such browsers and have a User Interface optimized for mobile experience.

C. The system software license shall be licensed as follows:

1. ACS Cloud Service

a. Shall provide for an unlimited number of Access Points depending on the license utilized
b. Shall provide for an unlimited number of concurrent users with no additional licensing.
c. Shall be licensed by the number of Access Points in common increments up to two hundred-fifty (250), two hundred and fifty-one (251+) and over shall be unlimited.
   1) When using a license for over fifty-one (51) Access Points the system shall include Microsoft Active Directory integration at no cost.

d. Shall be an annual fee paid to maintain the Cloud Service and provide regular updates.

2. ACS Host Server

a. Shall provide the same User Interface as the Cloud for ease of use.
b. Shall provide for an unlimited number of Access Points with no additional licensing.
c. Shall provide for an unlimited number of concurrent Clients with no additional licensing.
d. Shall provide Microsoft Active Directory integration with no additional licensing.
e. Shall have a Software Upgrade Plan to cover updates the software platform.

D. System Functions - The access control system software functions shall include the following:

1. User/Credential Management

a. Shall provide for an unlimited number of Users and Credentials with no additional licensing.
b. Shall provide an unlimited number of User Groups.
c. Users configuration shall have the following attributes:
   1) First name, middle initial and last name.
   2) User Image
   3) Alert email address for the User to receive Alert emails

4) Ten (10) customizable User Defined Fields
5) Web Access with customizable User Roles to define what the User can view and edit in the Client. Passwords for Web Access shall be forced to use strong passwords.
6) Unlimited number of credentials using either a Badge, PIN or Mobile credential
7) Can reside in an unlimited number of User Groups.
8) Can be associated with Custom Rules

d. When deactivating a User, the system shall deactivate all associated credentials with that User. Any credential can be deactivated without deactivating the associated User.
e. Microsoft Active Directory Integration
1) System shall allow for the integration to Microsoft Active Directory unless it is utilizing a Cloud Service license of under fifty (50) Access points. This Integration will synchronize Users from Active Directory to the ACS Host. The ACS Host will poll the Active Directory server regularly for changes and synchronize those changes to its database.

2. Access Point Programming and Management

a. Provide an easy to use wizard to add Access points to the software. Shall include the ability for a technician to use an Android or Apple mobile device to enroll devices by scanning the MAC address of the Access Point.
b. Wizard shall include a full test of all Access Point components
c. Configurable door latch interval
d. Input enable/disable and configuration
e. Number of Access Point Groups - Unlimited

3. Weekly Schedules

a. Number of Weekly Schedules - Unlimited
b. Interval assignments - Any day of the week with optional Holiday Over Ride

4. Weekly Rules - Unlimited number
5. Holidays - Unlimited number
6. Alarm and Event Logging - provide for logging of all system alarms and events chronologically including time and date stamp. Specific alarm conditions monitored shall be included but not limited to:

a. Door Unauthorized Open Alarm
b. Door Extended Open Alarm
c. Reader-Controller Tamper Alarm
d. Device Offline Alert

7. System Scheduling - provide for scheduling of events including:

a. Access Point or Access Point Group unlock for specified Schedule.
b. Access Point or Access Point Group unlock with specified Badge(s), Access Point(s) shall remain locked until an authorized Credential is read.

8. System Dashboards – Monitoring Attributes

a. Shall provide unlimited customizable Dashboards for Monitoring of the ACS. Each dashboard shall contain four (4) customizable widgets. These Dashboards shall be fully customizable, able to filter on all events, able to filter on all devices where applicable and include the following:
1) Ability to display single Access Point status with the following:
a) Live update of door status including physical door status and all event history
b) Ability to Admit entry for the latch interval time
c) Ability to Lock, Unlock and Lockdown the Access Point

d) Display User images if available
2) Ability to display multiple Access Points, up to twelve (12) in a single widget with the following:
a) Live update of door status
b) Ability to Admit entry for the latch interval time
c) Ability to Lock, Unlock and Lockdown the Access Point
3) Ability to display History in the system filtered to be filtered by Users, Groups and/or Access Points.
4) Ability to add a single Admit widget for an Access Point to admit entry for the latch interval.
5) Ability to add a Lockdown widget to Lockdown a single Access Point, a Group of Access Points or All Access Points.
6) Ability to show User profiles for a single Access Point or multiple Access Points. The User Profile shall show the event and Users image if applicable.

b. Dashboards shall be able to be restricted by User Groups and/or Areas.
c. Dashboards shall also include an unlimited number of Floor Plans to be created and displayed in the system. Floor Plans shall show the status of all doors displayed on the Floor Plan at creation. Floor Plans shall allow for a User to Admit, Unlock or Lockdown a single Access Point or multiple Access Points shown on the Floor Plan.

9. System Alerts – Alarm Attributes

a. System shall provide a dedicated page for monitoring of Alerts in the system. These alerts shall notify the User of the number of Alerts in the system and can easily configure email and/or SMS alerts to notify Users.
b. Alerts shall queue in the system until they are Acknowledged and Cleared. Notes can be added to individual reports.
c. Alerts shall be able to be Disabled or set to Auto-Clear from the queue.
d. The types of Alerts available shall be:
1) Unauthorized Open
2) Extended Open
3) Tamper
4) AUX
5) REX
6) Credential Rejected
7) Credential Expired
8) Credential Over Limit

10. Reports

a. System shall provide both customizable ad hoc reporting and scheduled reports that can be emailed on a daily or weekly basis.
b. Reports shall be able to be saved as standard PDF or CSV files.
c. Reports shall be able to be filtered by all attributes within the report.
d. The following reports should be included at a minimum:
1) History
2) Users
3) Access Points
4) Schedules
5) Holidays
6) Attendance
7) Permissions

11. Custom Rules Engine

a. System shall provide a flexible Custom Rules Engine to trigger unique actions from various events in the system. The Engine shall allow for the use of multiple triggers in the system to configure these events. System triggers shall include but not be limited to:
   1) A User's Credential is Accepted or Rejected
   2) An Access Point has a specific Alert or any Alert
   3) The Access Point has disconnected
   4) During or not during a configured Schedule
   5) At an Access Point or Access Point Group

b. System Actions shall include but not be limited to:
   1) Email a User or User Group
   2) Lockdown an Access Point or Access Point Group
   3) Create an Alert in the system
   4) Unlock an Access Point or Access Point Group
   5) Disable a Credential

E. ACS Host Server - Operating System (If Applicable)
   1. The system software shall be based on Microsoft Windows Server 2012r2 or 2016.
   2. The system shall support running in a Virtual Environment.

2.04 HARDWARE COMPONENTS

A. ACS Local Host Server (If Applicable)
   1. Minimum hardware requirements

      a. Processor type and speed – Intel i5 or greater
      b. System memory requirements – 8GB RAM minimum
      c. Minimum hard drive space – 500GB
      d. Network card - Ethernet 10/100 Base-T Minimum
      e. Minimum monitor resolution - 1024 x 768 pixels
      f. Monitor card - SVGA video card with minimum 256Mb memory.
      g. Keyboard and mouse - USB keyboard and optical scroll mouse

   2. The ACS Client shall provide operator interface, interaction, display, control, and dynamic and real-time monitoring.

B. Field Devices
   1. Functionality

      a. Field equipment shall include IP based Reader-Controllers and IPBridges.
      b. Data exchange between the ACS Host and the IP based Reader-Controllers shall include down-line transmission of commands, software, and databases to IP based Reader-Controllers.
      c. The up-line data exchange from the IP based Reader-Controller to the ACS Host shall include status data such as status reports, and entry-control records.

   2. IP Bridge - The system shall have available an IPBridge module to interface existing analog or IP access control equipment to the access control system specified herein over the IP network.

      a. The IP Bridge shall have the capacity to interface to up to three (3) doors.
         1) The IP Bridge shall have two (2) RJ-45 network connections, allowing connection of up to thirty-two (32) IPBridges to a single network switch port.

      b. The IP Bridge shall eliminate the need for a stand-alone door controller with a capacity of:

1) 64,000 cardholders
2) 5000 access events
3) 32 time zones per cardholder

c. The IP Bridge shall have the ability to be configured and accessed by the ACS Host software.
   1) Information shall be exchanged on an asynchronous interrupt basis without the need for polling by the ACS Host software.
   2) IP Bridge microcode updates shall be provided over the network, when necessary.

d. The IP Bridge shall support AES encryption.
e. The IP Bridge shall have the ability to function autonomously in a Stand-Alone mode to reduce network traffic and system load.
f. The IP Bridge shall support the following inputs (per access point):
   1) Three (3) configurable sensor inputs for door sense, request to exit and auxiliary.
   2) Wiegand card reader connection up to 500 feet.

g. The IP Bridge shall support the following outputs (per access point):
   1) Door Control relay (for electric lock, rated 2.0 A @ 30 VDC, form C)
   2) Wiegand interface
      a) Power - 10 VDC regulated, regardless of input power to IP Bridge
      b) LED control
      c) beeper control
   3) Two (2) TTL outputs
   4) Auxiliary 12 VDC power

h. The IP Bridge shall have the capability to be powered by IEEE 802.3af POE, IEEE 802.3at POE+, or by 12 or 24 VDC
i. User
   1) Indicators
      a) Power
      b) Network Status
      c) Door Status (one indicator per door)
   2) Programming - Microcode flash upgradeable
   3) Dual-mode reset button - Power-cycle IPBridge and Reset-to-Factory defaults

j. Physical and Environmental
   1) Operating Temperature - -40º to +50º C
   2) Humidity - 0 - 90%, non-condensing
   3) Enclosure
      a) PC/ABS Flame-retardant per UL94 V-0
      b) Form Factor - DIN Rail Mounting
      c) Dimensions – 6.3” x3.6” x 2.3”

3. Reader-Controller - The reader-controller shall have the following properties:

   a. Credentials
      1) Proximity Model
         a) Card Formats Read - Proprietary RFID and HID Proximity
         b) Bluetooth Low Energy
         c) Operating Frequency - 125 KHz (FSK modulation)
         d) Proximity Read Time - <250msec
         e) Read range - 2 - 5 inches
      2) Multi-Technology Card Model
         a) Card Formats Read - MiFare, PIV, iClass

b) Bluetooth Low Energy
c) Operating Frequency - 13.5 MHz (ISO 14443A & 14443B)

b. Stand-alone Capability
1) 64,000 cardholders
2) 5000 access events
3) 32 time zones per cardholder

c. Input/output
1) Inputs - Two configurable (Default usage - door sense, request for exit/auxiliary)
2) Outputs
a) One solid state relay controlling the electric lock rated at 12vdc 600ma.

d. Communications Interface
1) Ethernet, TCP/IP via RJ-45 connector.
2) Non-polled asynchronous messaging.
3) Communication mode configurable between Network-Client and Network-Server.

e. Security
1) Tamper detection via accelerometer
2) Encrypted lock control with optional module

f. Electrical
1) Power – PoE and 12vdc
2) Operating Current - <150mA peak
3) Auxiliary Power Output – 12vdc @ 600ma

g. User
1) LED Indicators (2) - reader status, network connection
2) Programming - Microcode flash upgradeable
3) Dual-mode reset button - Power-cycle reader and Reset-to-Factory defaults

h. Physical and Environmental
1) Operating Temperature - -40º to +50º C
2) Humidity - 0 - 100%
3) Weather Resistance – Conformal Coated components for weather resistance
4) Certifications
a) UL-294 Compliant
b) FCC 47 CFR Part 15
c) RSS-210
d) ETSI EN 300, EN 330-2, EN 301 489-1
5) Enclosure
a) Durable U/V stabilized, flame-retardant ABS
b) Form Factor – Wall mount and mullion mount
c) Dimensions –
i. Mullion (5.1” x 1.7” x 0.71”)
ii. Wall mount (5.1” x 3.25” x 0.17”)

2.05 SYSTEM PERFORMANCE

A. The system shall use a single database for access-control and credential-creation functions.

B. Distributed Processing - The system shall be a fully distributed processing system so that information, including time, date, valid codes, access levels, and similar data, is downloaded to the IP based Reader/Controllers so that each IP based Reader-Controller can make access-control decisions for that location. If communications to ACS Host Workstation is lost, all IP based Reader-Controllers shall automatically buffer event transactions until

communications are restored, at which time buffered events shall automatically be uploaded to the ACS Host.

C. System Capacity
   1. Number of Locations - Unlimited (dependent on license)
   2. Access Points - Unlimited (dependent on license)
   3. Total access credentials - Unlimited

D. System Response to Alarms
   1. Reader-Controllers network shall provide a system end-to-end response time of 3 second or less for every device connected to the system with typical network latency.
   2. Alarms shall be annunciated at the ACS Host within 3 second of the alarm occurring at a IP based Reader-Controller or device controlled by a local IP based Reader-Controller, and within 1 second if the alarm occurs at the ACS Host with typical network latency.
   3. Alarm and status changes shall be displayed within 1 second after receipt of data by the ACS Host with typical network latency.
   4. All graphics shall be displayed, including graphics-generated map displays, on the console monitor within 15 seconds of alarm receipt at the security console with typical network latency.

E. Network
   1. The TCP/IP network interconnecting the system components shall provide automatic communication of status changes, commands, field-initiated interrupts, and other communications required for proper system operation.
   2. Network communication issues shall not require operator initiation or response, and the network shall return to normal after partial or total network interruption such as power loss or transient upset.
   3. Data Line Supervision - The system shall monitor the status of the data transmission lines with the use of heartbeat messages. The loss of the heartbeat messages will cause an alarm condition within the ACS host, and the reader-controller to switch to standalone mode.

F. Environmental - The system shall be capable of withstanding the following environmental conditions without mechanical or electrical damage or degradation of operating capability:
   1. Interior, Controlled Environment - System components, except computer workstation units, installed in air-conditioned temperature-controlled interior environments shall be rated for continuous operation in ambient conditions of 2 to 50 deg C dry bulb and 0 to 90 percent relative humidity, non-condensing. .
   2. Interior, Uncontrolled Environment - System components installed in non-air-conditioned non-temperature-controlled interior environments shall be rated for continuous operation in ambient conditions of minus 20 to plus 50 deg C) dry bulb and 0 to 100 percent relative humidity, non-condensing.
   3. Exterior Environment - System components installed in locations exposed to weather shall be rated for continuous operation in ambient conditions of minus 40 to plus 120 deg F minus 40 to plus 50 deg C dry bulb and 0 to 100 percent relative humidity, condensing. Rate for continuous operation where exposed to rain as specified in NEMA 250, winds up to 85 mph (137 km/h) and snow cover up to 24 inches (610 mm) thick.

PART 3 - EXECUTION

3.01 EXAMINATION

G. Examine pathway elements intended for cables. Check raceways, cable trays, and other elements for compliance with space allocations, installation tolerances, hazards to cable installation, and other conditions affecting installation.

H. Examine roughing-in for LAN and control cable conduit systems to PCs, IP based Reader-Controllers, Reader-controllers, non-IP readers, doors, and other cable-connected devices to verify actual locations of conduit and back boxes before device installation.

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

3.02 PREPARATION

J. Comply with recommendations in SIA CP-01.

K. Comply with EIA/TIA-606, "Administration Standard for the Telecommunications Infrastructure of Commercial Buildings."

L. Develop Project planning forms to suit Project. Fill in all data available from Project plans and specifications and publish as Project planning documents for review and approval.
   1. Record setup data for control station and workstations.
   2. For each Location, record setup of IP based Reader-Controller features and access requirements.
   3. Propose start and stop times for shifts and holidays, and match up permissions for doors.
   4. Set up groups, and list inputs and outputs for each IP based Reader-Controller.
   5. Prepare and install alarm graphic maps.
   6. Discuss badge layout options; design badges.
   7. Complete system diagnostics and operation verification.
   8. Prepare a specific plan for system testing, startup, and demonstration.
   9. Develop acceptance test concept and, on approval, develop specifics of the test.

M. In meetings with Architect and Owner, present Project planning documents and review, adjust, and prepare final setup documents. Use final documents to set up system software.

3.03 CABLING

A. Comply with NECA 1, "Good Workmanship in Electrical Contracting."

B. Install cables and wiring according to requirements in Division 28 Section "Conductors and Cables for Electronic Safety and Security."

C. Wiring Method: Install wiring in raceway except within consoles, cabinets, desks, and counters. Conceal raceway and wiring except in unfinished spaces.

D. Wiring Method: Install LAN cables using techniques, practices, and methods that are consistent with Category 6A rating of components and that ensure Category 6A performance of completed and linked signal paths, end to end.

E. Install cables without damaging conductors, shield, or jacket.

F. Boxes and enclosures containing security system components or cabling, and which are easily accessible to employees or to the public, shall be provided with a lock. Junction boxes

and small device enclosures below ceiling level and easily accessible to employees or the public shall be covered with a suitable cover plate and secured with tamperproof screws.

3.04 CABLE APPLICATION

A. Comply with EIA/TIA-569, "Commercial Building Standard for Telecommunications Pathways and Spaces."

B. Cable application and requirements shall be compliant with manufacturer's recommendations.

3.05 GROUNDING

A. Comply with Division 26 Section "Grounding and Bonding for Electrical Systems."

B. Comply with IEEE 1100, "Power and Grounding Sensitive Electronic Equipment."

C. Ground cable shields, drain conductors, and equipment to eliminate shock hazard and to minimize ground loops, common-mode returns, noise pickup, cross talk, and other impairments.

D. Bond shields and drain conductors to ground at only one point in each circuit.

3.06 IDENTIFICATION

A. In addition to requirements in this Article, comply with applicable requirements in Division 26 Section "Identification for Electrical Systems" and with TIA/EIA-606.

B. Label each terminal strip and screw terminal in each cabinet, rack, or panel.

1. All wiring conductors connected to terminal strips shall be individually numbered, and each cable or wiring group being extended from a panel or cabinet to a building-mounted device shall be identified with the name and number of the device as shown.
2. Each wire connected to building-mounted devices shall be numbered at the device and shall be consistent with the associated wire connected and numbered within the panel or cabinet

3.07 INSTALLATION

A. Install all equipment in accordance with the manufacturer's installation manuals, wiring diagrams and recommendations.

B. Install, configure and test software and databases for the complete and proper operation of systems involved. Assign software license to Owner.

3.08 FIELD QUALITY CONTROL

A. Contractor shall engage a factory-authorized and trained service representative to inspect, test, and adjust components and equipment installation.

1. Results shall be reported in writing.

B. Contractor shall perform the following field tests and inspections and prepare test reports:

1. LAN Cable Procedures - Inspect for physical damage and test each conductor signal path for continuity and shorts. Use Class 2, bidirectional, Category 5 tester. Test for faulty connectors, splices, and terminations. Test according to TIA/EIA-568-1, "Commercial

Building Telecommunications Cabling Standards - Part 1 General Requirements." Link performance for UTP cables must comply with minimum criteria in TIA/EIA-568-B.

2. Test each circuit and component of each system. Tests shall include, but are not limited to, measurements of power supply output under maximum load, signal loop resistance, and leakage to ground where applicable. System components with battery backup shall be operated on battery power for a period of not less than 10 percent of the calculated battery operating time. Provide special equipment and software if testing requires special or dedicated equipment.
3. Operational Test - After installation of cables and connectors, demonstrate product capability and compliance with requirements. Test each signal path for end-to-end performance from each end of all pairs installed. Remove temporary connections when tests have been satisfactorily completed.

C. Contractor shall remove and replace malfunctioning devices and circuits and retest as specified above.

3.09 STARTUP SERVICE

D. Contractor shall engage a factory-authorized and trained service representative to supervise and assist with system startup service.

1. Representative shall complete installation and startup checks according to approved procedures that were developed in Section 3.03 and with manufacturer's written instructions.

E. Contractor shall engage a factory-authorized and trained service representative to train Owner's maintenance personnel to adjust, operate, and maintain security access system.

1. Representative shall develop separate training modules for the following:

    a. Computer system administration personnel to manage and repair the LAN and databases and to update and maintain software
    b. Operators who prepare and input credentials to man the control station and workstations and to enroll personnel
    c. Security personnel
    d. Hardware maintenance personnel
    e. Corporate management

END OF SECTION

SECTION 28 2300

VIDEO SURVEILLANCE SYSTEM

PART 1 – GENERAL

1.01 REQUIREMENTS

A. General Requirements

1. The specified product shall be an open video platform designed for use in any video application.
2. The specified software shall include, free of charge, any API or SDKs necessary to integrate 3rd party devices and systems.
3. The specified Video Management solution's architecture should include Desktop, Server, Mobile, and Cloud applications.

1.02 DEFINITION & STANDARDS

A. General Abbreviations, acronyms, and standards

1. ACC: Video Codec “Active Content Compression
2. ADDS: Active Directory Domain Services
3. AGC: Automatic gain control
4. API: Application Programming Interface
5. AVI: Audio Video Interleave
6. Bit Rate: The number of bits/time unit sent over a network
7. DHCP: Dynamic Host Configuration Protocol
8. FPS: Frames per Second
9. FTP: File Transfer Protocol
10. GbE: Gigabit Ethernet (1000Mbps)
11. H.264/5 (Video Compression Format)
12. HTTP: Hyper Text Transport Protocol
13. IEEE 802.1x: Authentication framework for network devices
14. IP: Internet Protocol
15. JPEG: Joint Photographic Experts Group (image format)
16. LAN: Local Area Network
17. MJPEG: Motion JPEG
18. MKV: Matroska video format
19. MP4: MPEG Layer-4 Audio
20. MPEG: Moving Picture Experts Group
21. NTP: Network Time Protocol

22. NTSC: National Television System Committee – a color encoding system based on 60Hz
23. ONVIF: Global standard for the interface of IP-based physical security products
24. PoE: Power over Ethernet (IEEE 802.3af/at) standard for providing power over network cable
25. PTZ: Pan/Tilt/Zoom
26. SDK: Software Development Kit
27. RAID: Redundant Array of Independent Disks
28. RTSP: Real-Time Streaming Protocol
29. RADASS: Resolution and Algorithmic Data Adaptive Scaling System
30. SMTP: Simple Mail Transfer Protocol
31. SSL: Secure Sockets Layer
32. TCP: Transmission Control Protocol
33. TLS: Transport Layer Security
34. Unicast: Communication between a single sender and single receiver on a network
35. VMS: Video Management System

1.03 QUALITY ASSURANCE

A. Basic Level of Support

1. Complete product and technical data specification sheets that include all material and equipment shall be provided by the System Integrator and be available freely online.

1.04 PROPOSAL SUBMITTALS

A. Product Documentation

1. Complete product and technical data specification sheets that include all material and equipment used on this project shall be included in the submitted solution proposal.

B. System Documentation

1. The System Integrator will provide
   - List of all equipment with part numbers, manufacturer, firmware, and assigned IP addresses.
   - Locations and details for all components to be installed under this scope of work

C. Planning

1. Placement Diagram - the System Integrator will provide a placement diagram showing the proposed location of all system hardware devices.
2. System Calculation - the System Integrator will provide a calculation of all network bandwidth and storage requirements for System Servers to ensure proper planning of computing and networking infrastructure.

D. Qualifications

1. Manufacturer shall have a minimum of five (5) years' experience in producing IP video equipment and software. Must also possess current New Mexico ES-3 & ES-7 licenses with a service organization within 125 miles of the installation.

2. Installers shall be trained and authorized by the Manufacturer to install, integrate, test, commission, and provide ongoing support for the solution.
3. Personnel knowledgeable in local, state, province and national codes, and regulations. All work shall comply with the latest revision of the codes or regulations. When conflict exists between local or national codes or regulations, the most stringent codes or regulations shall be followed.
4. Installing company to be Native American and Veteran owned.

1.05 ONGOING SUPPORT & WARRANTY

A. Integrator Warranty

1. The security system VMS software and labor furnished by the integrator including wiring, software, hardware and third party products shall be fully warranted for parts, materials and labor for a minimum of 1 year from date of the final acceptance of the Video Surveillance System.

B. Software Licensing & Warranty

1. Software licensing should be on a per device basis (e.g. 1 x license for 1 IP Camera or I/O device) with no base license for additional features or capabilities.
2. The VMS Software should be completely free for live streaming or playback of offline media files (images, videos).
3. Lifetime software upgrades shall be provided by the Manufacturer without cost and without the need for an annual maintenance agreement.

PART 2 – PRODUCT

2.01 VMS OVERVIEW

A. VMS Software Components

1. The System shall be comprised of four (4) applications which work together seamlessly.
    - Cloud - a cloud application that enables simple remote connectivity, viewing, and management of an unlimited number of systems and users.
    - Server - a media server responsible for discovering, connecting to, and managing system users, devices, and associated data.
    - Desktop - a desktop application capable of acting as a stand-alone media player or as a client application for connecting to and managing systems, with a minimum of (3) seats.
    - Mobile - a mobile application for iOS and Android devices that allows users to connect to, view, search, and control IP cameras over Wifi or Data networks.

B. VMS Developer & Integration Tools

1. The VMS shall have built-in developer tools which are accessible from any System Server's Web Admin Interface (compatible with all major browsers) and should include, at a minimum:
    - A Generic Events Generator - a tool which helps build HTTP Generic Event calls, a method of sending events from 3rd party systems to the VMS, which can be used to trigger system actions in the VMS.

- Server API – SUNAPI implementation that gives developers the ability to access every system feature available.
- API Change Log - list of breaking changes in API from version to version
- Video Source Integration SDK - provides the ability to integrate virtually any live or recorded video source (IP Cameras, NVRs, DVRs, etc) into the VMS with methods for discovering, displaying, analyzing and recording video, as well as integrating device I/O ports and related motion detection information.
- Storage SDK - provides the ability to integrate potential storage into System. It allows developers to read from or write to any storage location: local, remote, and even cloud one. Creating a storage plugin requires implementing standard functions such as: I/O stream, if file exist, delete file, list of files in the folder, etc.Storage SDK also contains an example for using an FTP server as a storage location.

C. VMS SYSTEM ARCHITECTURE

1. The VMS shall have a Server Hive Architecture wherein:
   - All servers in a system are equal and synchronize system databases in real-time
   - A user can connect to any system server to see and manage the entire system
   - Servers support automatic camera failover to ensure limited loss of video recording in the event of hardware or network failure.
   - Servers will use a SQLite - a free database technology - included in the installation package
2. The VMS shall support one-click system wide updates.
   - System Administrators shall be able to upgrade an entire system via a single button in the Desktop Application.
   - System Administrators shall be able to upgrade on demand to the latest release or specific builds with specific functionality or bug fixes
   - System Administrators shall be able to apply an OTA (over-the-air) update
   - System Administrators shall be able to generate a URL to download a portable system- specific update package in .zip file format which can be used to update servers without an active Internet connection.
3. The VMS will use secure technologies for inter-application communication and security.
   - OpenSSL for network connections - deprecated and insecure protocols and use only TLS v1+.
   - Server -> Client (Mobile, Desktop, Web) Communications - HTTPS Email - TLS / SSL - TLS is the default option for the Email Server.
   - Salted/Hashed Passwords - Local Credentials will be protected using a salted MD5 hash, Cloud Credentials should use a complex multi-level hash
4. The VMS will not require any licenses to increase the number of supported devices, users, or servers.

2.02 - VMS SERVER APPLICATION

A. Supported Operating Systems

The VMS Server application shall be able to run on any of the following operating systems.

Operating System	Versions
Microsoft Windows	• Windows 7 • Windows 8 • Windows 8.1 • Windows 10 • Windows Server 2008 • Windows Server 2008 R2 • Windows Server 2012 • Windows Server 2012 R2 • Windows Server 2016 (Long-Term Servicing Channel) 1607 • Windows 10 Enterprise
Ubuntu Linux	• Ubuntu 14.04 LTS: "Trusty Tahr" • Ubuntu 16.04 LTS: "Xenial Xerus"

B. MINIMUM COMPATIBLE COMPUTING HARDWARE

1. The VMS Server application will be capable of operating on any hardware able to run a compatible operating system.
2. The VMS Server will be capable of recording 128 dual-streaming IP cameras (256 streams) on a single core of an Intel Core i3 processor.

C. INITIAL INSTALLATION & SETUP

1. The VMS Server application installer should not exceed 100 MB (megabytes).
2. The VMS Server application should be a publicly available, free download.
3. The VMS Server application should require no prerequisite proprietary or 3rd party software and database technologies during installation.
4. The VMS Server installation process should require no user input once initiated
5. After installation is complete the VMS server setup process will allow system administrators to create a new system or to merge newly installed server(s) with existing systems.

D. FEATURES

1. The VMS Server Application shall automatically discover, stream, and record any ONVIF Profile S IP camera located on the same subnet as the server application.
2. The VMS Server Application shall manually discover, stream, and record RTSP, HTTP, or

UDP (multicast, unicast) streams.

3. The VMS Server application shall support up to 1000 concurrent TCP connections
4. The VMS Server application shall record and stream video of any resolution and frame rate, limited only by hardware.
5. The VMS Server application shall support automatic camera failover without any additional licenses. 6. The VMS Server application will support an unlimited number of users and custom user roles
7. The VMS Server application shall support any type of storage medium - HDD's, SSD's, SD cards, DAS, NAS, or other network-attached storage devices or locations.
8. The VMS Server application shall support LDAP / Active Directory / Open LDAP integration for user login credential management
9. The VMS Server application shall record and stream H.264, H.265, and MJPEG streams
10. The VMS Server application shall record and stream AAC, PCM (Mu-Law, A-law), g726, and MP3 audio. The VMS Server application shall transcode streams on demand for delivery to 3rd party systems or devices in H.265, H.264, MJPEG or WebM codecs.
11. The VMS Server application shall be able to provide pass-through high or low-res HLS streams from connected devices.
12. The VMS Server application shall store archive indices in the same location as recorded video files
13. The VMS Server application shall allow system administrators to recover archives from any storage medium using a re-index archive feature.
14. The VMS Server application will contain a boolean events engine allowing operators to program and trigger system actions based on system, connected device, or HTTP events sent from 3rd party system or device.
15. The VMS Server application shall be able to send HTTP PUT or GET requests to 3rd party systems or devices.
16. The VMS Server application shall support IPv4 or IPv6 addressing
17. The VMS Server application shall allow operators to set custom network routing configurations for system servers to optimize network routing and usage.
18. The VMS Server application shall allow operators to monitor the CPU, RAM, NIC, and HDD usage in real time.
19. The VMS Server application shall track all operator actions to allow audits
20. The VMS Server application shall generate automatic crash files every time there is an unexpected crash of the Server application.
21. The VMS Server application shall allow operators to change the size of reserved disk space for storage drives.
22. The VMS Server application shall automatically disable any system drive (drive containing the operating system) in computing hardware with more than one drive to ensure the operating

system drive does not become full.

23. The VMS Server application shall support configuration and events from binary I/O contactson supported devices - including IP cameras and I/O devices.
24. The VMS Server application shall support sending email notifications via SMTP using TLS, SSL or unsecured connections.
25. The VMS Server application shall support scheduled backup of recording archives to local, networked, or cloud storage locations.
26. The VMS Server application shall allow on-demand backup of recording archives to local, networked, or cloud storage locations.
27. The VMS Server application shall allow concurrent-recording of all connected cameras / streams to two (2) servers in real-time. The VMS Server application will allow server-side, CPU-based motion analysis for all connected IP cameras with no perceptible increase (<3%) in CPU usage.
28. The VMS Server application will require no dedicated GPU in order to perform at maximum capacity. 31. The VMS Server application will have a web administration interface thatallows users to view live or recorded video from a single camera at a time in high or lowresolutions.
32. The VMS Server application will have a web administration interface that allows system administrators to view real-time server health monitoring statistics (CPU, NIC, andHDD usage).
33. The VMS Server application will have a web administration interface that allows operators to disconnect the VMS Server from the VMS cloud application.
34. The VMS Server application will have a web administration interface that allows users to viewall available servers in the system.
35. The VMS Server application will have a web administration interface that allows operators to switch between server interfaces.
36. The VMS Server application will have a hidden advanced page that gives system administrators the ability to modify advanced system settings.
37. The VMS Server application will support any RAID configuration of storage medium

2.03 - VMS DESKTOP APPLICATION

A. Supported Operating Systems

Operating System	Versions
Microsoft Windows	• Windows 7 • Windows 8 • Windows 8.1 • Windows 10 • Windows Server 2008 • Windows Server 2008 R2 • Windows Server 2012 • Windows Server 2012 R2 • Windows Server 2016 (Long-Term Servicing Channel) 1607 • Windows 10 Enterprise
Ubuntu Linux	• Ubuntu 14.04 LTS: "Trusty Tahr" • Ubuntu 16.04 LTS: "Xenial Xerus"
Apple / Mac	• OSX 10.11: "El Capitan" • OX 10.12: "Sierra" • OSX 10.13: "High Sierra"

B. Minimum Hardware Requirements

1. The VMS Desktop application will be capable of operating on any hardware able to run a compatible operating system with a CPU that supports OpenGL 2.1 and Intel HD Graphics 3000 (or higher).
2. The VMS Desktop application shall not require any dedicated graphics drive to work at full capacity (64 streams on a 64 bit OS, 24 streams on a 32 bit OS) and shall use the CPU for all video decoding and rendering.

C. INSTALLATION & CONFIGURATION

1. The VMS Client application installer should not exceed 100 MB (megaybytes).
2. The VMS Client application should be a publicly available, free download.
3. The VMS Client application should require no prerequisite proprietary or 3rd party software and database technologies during installation.
4. The VMS Client installation process should require no user input once initiated.

D. FEATURES

1. The VMS Desktop application will have the following basic structure:
    - Navigation Panel - with a main menu button, an interactive cloud-login icon, tabbed layouts, minimize and maximize icons, a contextual help icon, and a close application

icon.

- Resource Panel (Left) - contains all system resources (Servers, Devices, Users, Layouts, Offline files, etc) with collapsible structure and a keyword search mechanism to allow operators to quickly search for a display live streams / cameras, offline video and image files, or any combination thereof.
- Notifications Panel (Right) - shows all system or rules-engine generated notifications which can be clicked on to display relevant resource in the Viewing Grid
- Timeline Panel (Bottom) - allows for navigation and search of recorded video files
- Viewing Grid (Main Viewing Area) - a flexible adaptive grid interface which allows operators to create and share customized layouts of system resources.

2. The VMS Desktop application shall allow operators to view and interact with the following types of media:
    - Live Streams: H.265, H.264, MJPEG
    - Offline Media: AVI MKV MP4 MOV TS M2TS MPEG MPG FLV WMV 3GP JPG PNG GIF BMP TIFF
    - I/O Devices: Status and Triggers
3. Servers: Real-Time Server Health Monitoring StatusThe VMS Desktop application shall allow the operator to scroll to zoom in to any part of the Viewing Grid.
4. The VMS Desktop application shall allow operator to drag & drop to reassign cameras from one server to another server.
5. The VMS Desktop application will have a flexible timeline that allows operators to view the dates of any and all archived video in the System for a specific camera, or groups of cameras.
6. The VMS Desktop application will allow operators to manually create bookmarks - with a start time, end time, name, description, and tags - for later search. Bookmarks shall also be able to be created using the Rules engine.
7. The VMS Desktop application shall allow operators to create Soft Triggers - programmable, customizable buttons which sit on top of streams in the Viewing Grid - to trigger any available system action.
8. The VMS Desktop application shall have icons located on the top of live camera streams which allow operators to dewarp fisheye cameras, control PTZ cameras, apply client-side image enhancement, execute smart motion search, create zoom windows, rotate items to any orientation, and activate stream or file info.
9. The VMS Desktop application shall allow operators to create Zoom Windows (up to 63 zoom windows on a single item in a 64 bit OS, 23 zoom windows in a 32 bit OS) - a magnified view of a part of a live stream, recorded videos, or static images.
10. The VMS Desktop application shall allow operators the ability to execute a Smart Motion search by selecting a subset of a live camera stream with results shown in red on the flexible timeline. Smart Motion search should be able to search a year (12 months, 365 days) of archived video in less than one (1) second.

11. The VMS Desktop application will allow users to search live cameras by name, manufacturer, IP address, MAC address, and status (e.g. live).
12. The VMS Desktop application shall allow operators to search video archives by date and time with a responsive, adaptive timeline.
13. The VMS Desktop application will allow operators to customize the background image of the application with supported image types.
14. The VMS Desktop application will support digital mapping by allowing operators to add and customize background images - including opacity and number of grid points.
15. The VMS Desktop application will utilize adaptive scaling technology to automatically switch between high and low resolution streams during live and recording playback to optimize CPU and network usage.
16. The VMS Desktop application will allow operators to log in to the Cloud application in order to quickly connect to any shared system.The VMS Desktop application will allow operators to quickly switch between previously connected or cloud-accessible systems using searchable tiles that show system name and status.
17. The VMS Desktop application will have a Storage Analytics feature allowing operators to analyze storage capacity of the system based on available drives and real-time and historical bandwidth analysis.
18. The VMS Desktop application will allow management and configuration of all System devices, users, and resources in a single unified interface.
19. The VMS Desktop application will allow fast-forward and fast-reverse of archived video up to 16x normal speed.
20. The VMS Desktop application will show operators which system server they are connected to.
21. The VMS Desktop application will allow operators to connect to previous versions by automatically downloading and switching to compatible versions.
22. The VMS Desktop applications will automatically discover available systems on the same network as the computer running the Desktop application.
23. The VMS Desktop application will automatically recover and reconnect to a system in the instance the server the operator is connected to becomes inaccessible for any reason.
24. The VMS Desktop application will allow operators to show or hide adaptive thumbnails in the timeline panel.
25. The VMS Desktop application will allow operators to synchronize all items on a layout or disable synchronization to view live and recorded video at the same time.
26. The VMS Desktop application will have adaptive settings dialogs, allowing operators to switch dialog content while the dialog is open by clicking on a resource.
27. The VMS Desktop application will allow batch configuration of camera recording schedules, fps, and quality.

28. The VMS Desktop application will allow operators to drag and drop multiple system resources onto the Viewing Grid at the same time.
29. The VMS Desktop Application will allow administrators to modify time synchronization settings for the system to utilize online resources (NTP servers) or to set a dedicated local time server.
30. The VMS Desktop Application will allow system administrators to view a full list of system cameras and devices in a single dialog.
31. The VMS Desktop application will allow operators to view, search and export all system events.
32. The VMS Desktop application will allow operators to view, search and export all system bookmarks.
33. The VMS Desktop application will allow operators to view, search, and export system logs.
34. The VMS Desktop application will allow operators to view, search, and export an audit trail of all operator actions and replay related video.
35. The VMS Desktop application will allow administrators to backup and restore the system database.
36. The VMS Desktop application will allow administrators to create an unlimited number of custom user roles.
37. The VMS Desktop application will allow administrators to create and share lockable layouts.
38. The VMS Desktop application will allow administrators to update layouts in real time.
39. The VMS Desktop application will allow users to record their screen in full resolution and up to 30fps.
40. The VMS Desktop application will allow users to add a local folder to add local files for search and playback.
41. The VMS Desktop application will have a Video Wall mode which will allow operators to control the application remotely.
42. The VMS Desktop application will have a Media Player mode which will allow operators to use the application as a media player.
43. The VMS Desktop application will remember past system connections and user credentials and will allow operators to quickly search for and switch between systems.
44. The VMS Desktop application will allow operators to adjust the aspect ratio and streaming quality (high resolution or low resolution) of items displayed on the viewing grid.
45. The VMS Desktop application will display I/O devices as an individual item on the viewing grid and allow operators to create custom names for inputs and output.
46. The VMS Desktop application will allow users to customize the layout of I/O panels on the item in the viewing grid including indicators for inputs and buttons for outputs.
47. The VMS Desktop application will allow users to de-warp any fisheye lens using automatic calibration or manual calibration without the need for any third (3rd) party SDKs.

48. The VMS Desktop application will allow users to create fully customizable viewing tours which include any combination of live video streams, offline videos, images, websites (or URLs), I/O devices, and Server health monitoring status.
49. The VMS Desktop application will allow system administrators to modify and save a shared layout to affect an instantaneous change to that layout on the VMS Desktop application of any user connected to the system viewing that layout (when the system administrator saves the layout the layout will update in real time for any user viewing that layout).
50. The VMS Desktop application will support two-way audio between operators and supported devices.
51. The VMS Desktop application will support audio alerts as an action that can be played on users' computers or connected system devices.
52. The VMS Desktop application will support PTZ presets and tours.The VMS Desktop application will support PTZ presets and tours in fisheye cameras using de-warp mode.
53. The VMS Desktop application will allow operators to schedule recording for connected cameras and devices with options to force minimum and maximum storage durations.
54. The VMS Desktop application will allow operators to configure pre and post recording for motion events.
55. The VMS Desktop application will allow operators to optimize camera streaming quality from connected devices automatically using low, medium, high, best quality selectors or manually in the camera.
56. The VMS Desktop application will allow users to export video by selecting an area on the timeline and right clicking to export.
57. The VMS Desktop application will support single video export in .avi, .mp4, or .mkv formats and will offer the option to transcode any client-side effects (image enhancement, de-warping, timestamps) as part of the exported video.
58. The VMS Desktop application will support multi-video export in an executable format to create a fully portable version of the VMS Desktop application including all exported video files.
59. The VMS Desktop application shall have a rapid review export feature which will allow operators to compress any length of video into a short video (e.g. export 8 hours of archives into a 30 second video clip).
60. The VMS Desktop application shall allow system administrators to activate or deactivate system licenses on Internet connected systems.
61. The VMS Desktop application shall allow users to force open an alarm layout triggered by any system or 3rd party event with one or many associated cameras or resources.
62. The VMS Desktop application will have a hidden configurable method of increasing the amount of items allowed on the viewing grid.
63. The VMS Desktop application shall allow users to adjust configuration of devices.

64. VMS will now allow analytics from Wisenet and other supported device with analytics (Axis, DW, Hikvisio)
65. The VMS Desktop application will force users to set the camera's initial password upon enrollment for best cyber security practices.

2.04 - MOBILE APPLICATION

A. Supported Operating Systems

Operating System	Versions
Google Android	• Android 4.0: "Ice Cream Sandwich" • Android 4.1, 4.2, 4.3: Jelly Bean • Android 4.4: "KitKat" • Android 5.0: "Lollipop" • Android 6.0: "Marshmallow" • Android 7.0, 7.1: "Nougat" • Android 8.0, 8.1: "Oreo"
Apple iOS	• iOS 5 • iOS 6 • iOS 7 • iOS 8 • iOS 9 • iOS 10 • iOS 11

B. Installation

1. The VMS Mobile application will be available as a free download from Google Play or Apple iTunes stores.

C. FEATURES

1. The VMS Mobile application will automatically discover available Systems on a local area network (LAN).
2. The VMS Mobile application will store past system connections and credentials and will allow users to quickly search for switch between systems.
3. The VMS Mobile application will have adaptive streaming and automatically adjust the stream being displayed based on network speed.
4. The VMS Mobile application will allow users to adjust streaming resolutions manually.
5. The VMS Mobile application will allow users to search for cameras by name.
6. The VMS Mobile application will allow fisheye de-warping of any fisheye lens without the need for any 3rd party SDK.
7. The VMS Mobile application will allow users to view live video from one system.
8. The VMS Mobile application will allow users to log in to the VMS Cloud layer in order to view and access all systems shared with a user.
9. The VMS Mobile application will allow users to control the display of any connected

"Lite Clients" in the system.

10. The VMS Mobile application will utilize a custom media player to render and display live thumbnails and video.
11. The VMS Mobile application will allow users to search video using a calendar.
12. The VMS Mobile application will allow users to search video using a flex timeline.

2.04 - VMS CLOUD APPLICATION

A. Supported Browsers

1. The VMS Cloud application will allow users to log in from any modern web browser (Google Chrome, Mozilla Firefox, Microsoft Edge, Opera, etc) from any type of device (mobile, pc, etc.)

B. FEATURES

1. The VMS Cloud application will be an optional add-on to the VMS requiring no additional licensing.
2. The VMS Cloud application will allow users to connect an unlimited number of systems to a single user account.
3. The VMS Cloud application will allow system administrators to share access to a system using only an email address.
4. The VMS Cloud application will allow system administrators to assign custom user roles when sharing system access.
5. The VMS Cloud application will allow users to quickly search for and connect to cloud-connected systems by name.
6. The VMS Cloud application will allow operators to view live or recorded video from one camera at a time on any cloud-connected system.
7. The VMS Cloud application will first attempt a direct connection to system servers using NAT Traversal technology and will be able to proxy traffic to ensure access to a system in the case of ISP or routing issues.
8. The VMS Cloud application will allow an unlimited number of connected users and systems with no additional licensing.
9. The VMS Cloud application will utilize secure networking technologies (OpenSSL, HTTPS) and a complex Salted MD5 hash for any stored passwords.

PART 1 GENERAL

1.01 SUMMARY

A. Section includes a full HD IP video camera.

B. Product - A IP video camera, with multi-streaming (H.265, H.264 and MJPEG) capability in a vandal resistant dome housing.

C. RELATED REQUIREMENTS

1.02 REFERENCES

A. Abbreviations

1. AGC - Automatic Gain Control

2. ARP – Address Resolution Protocol
3. AWB - Automatic White Balance
4. BLC – Back light compression
5. CBR – Constant Bit Rate
6. CVBS – Color, Video, Blanking, Sync
7. DHCP - Dynamic Host Configuration Protocol
8. DNR – Digital Noise Reduction
9. DNS - Domain Name Server
10. DDNS – Dynamic Domain Name Server
11. DSCP – Differentiated Services Code Point
12. fps - frames per second
13. FTP - File Transfer Protocol
14. GOV – Group of Video
15. GUI – Graphical User Interface
16. HD – High Definition
17. HTTP - HyperText Transfer Protocol
18. ICMP – Internet Control Message Protocol
19. IGMP - Internet Group Management Protocol
20. IP - Internet Protocol
21. JPEG - Joint Photographic Experts Group
22. MJPEG - Motion JPEG
23. MP - MegaPixel
24. MPEG - Moving Pictures Experts Group
25. NAS – Network Attached Storage
26. NTP - Network Time Protocol
27. PIM-SM - Protocol Independent Multicast-Sparse Mode
28. PoE - Power over Ethernet
29. PPPoE – Point to Point Protocol over Ethernet
30. RTP - Real-time Transport Protocol
31. RTCP – Real-Time Control Protocol
32. RTSP - Real-Time Streaming Protocol
33. SDK – Software Development Kit
34. SMTP - Simple Mail Transfer Protocol
35. SNMP – Simple Network Management Protocol
36. SSL – Secure Sockets Layer
37. TCP - Transmission Control Protocol
38. UDP - User Datagram Protocol
39. UPnP – Universal Plug and Play
40. VBR – Variable Bit Rate
41. VMS - Video Management System

42. WDR – Wide Dynamic Range
43. LDC – Lens Distortion Correction

B. Reference Standards
   1. Network - IEEE
      a. 802.3 Ethernet Standards
      b. 802.1x Port-based Network Access Control
   2. Video
      a. ISO / IEC 23008-2:2013, MPEG-H Part2 (ITU H.265, HEVC)
      b. ISO / IEC 14496–10, MPEG-4 Part 10 (ITU H.264)
      c. ISO / IEC 10918 – JPEG
      d. ONVIF – Profiles S and G
   3. Emissions
      a. FCC-47 CFR Part 15 Subpart B Class B
      b. CE EN 55022:2010
   4. Immunity - CE
      a. EN 50130-4:2011
      b. EN 61000-3-3:2014
      c. EN 61000-4-2:2009
      d. EN 61000-4-3:2006+A2:2010
      e. EN 61000-4-4:2012
      f. EN 61000-4-5:2014
      g. EN 61000-4-6:2009
   5. Safety
      a. UL listed
      b. CE EN 50581:2012 (hazardous substances)
   6. Ingress Protection and Vandal Resistance
      a. IEC EN 62262 - Degrees of protection provided by enclosures for electrical equipment against external mechanical impacts : IK08
      b. IEC 60068-2-75 : IK08

C. Definitions
   1. GOV (Group of Video object planes) - A set of video frames for H.264 and H.265 compression, indicating a collection of frames from the initial I-Frame (key frame) to the next I-Frame. GOV consists of 2 kinds of frames: I-Frame and P-Frame.
   2. Dynamic GOV – Dynamic assignment of GOV length based on the complexity of the scene to efficiently manage bitrate of the video stream and reduce the storage required.
   3. Multi-exposure wide dynamic range - Operation which automatically adjusts shutter speed to provide a wide range between dark and light areas visible at the same time, preventing backlighting issues. Long exposure is used for dark areas and a short exposure is used in light areas.
   4. Dynamic fps – Dynamic assignment of fps (frames per seconds) based on the movement of object(s) in the scene to efficiently manage bitrate of the video stream and reduce the storage required.

5. Smart Codec – Smart Codec that controls quantization parameter and dynamic fps in H.265 and H.264 to efficiently manage bitrate of the video stream and reduce the storage required.

1.03 SUBMITTALS

A. Product Data
   1. Manufacturer's printed or electronic data sheets
   2. Manufacturer's installation and operation manuals
   3. Warranty documentation

1.04 QUALIFICATIONS

A. Manufacturer shall have a minimum of five years' experience in producing IP video equipment.

B. Installers shall be trained and authorized by the Manufacturer to install, integrate, test, and commission the system.

1.05 DELIVERY, STORAGE AND HANDLING

A. Deliver the camera in the manufacturer's original, unopened, undamaged container with identification labels intact.

B. Store the camera in a temperature environment specified in section 2.04 Detailed Specification, protected from mechanical and environmental conditions as designated by the manufacturer.

1.06 WARRANTY, LICENSING AND SUPPORT

A. Manufacturer shall provide at least a limited 3 year warranty for the product to be free of defects in material and workmanship.

B. Manufacturer shall provide embedded camera video analytics free of license charges.

END OF SECTION

PART 2 PRODUCTS

2.01 EQUIPMENT

A. Manufacturer: Hanwha Techwin
   http://hanwha-security.com/

B. Type
   1. Indoor/Outdoor Dome Camera
   2. Panoramic, Flateye Camera
   3. Bullet Camera

C. Alternates: None

2.02 GENERAL DESCRIPTION

A. Video Compression and Transmission – The camera shall have the following properties relating to the video signals it produces.
   1. H.265, H.264 and MJPEG compression, each derived from a dedicated encoder and capable of being streamed independently and simultaneously

a. H.265 and H.264 – frame rates to maximum 60 fps at all resolution
b. MJPEG – frame rates to maximum 30 fps at all resolution

2. The camera shall be able to configure up to 10 independent video stream profiles with differing encoding, quality, frame rate, resolution, and bit rate settings.
3. The camera shall be able to configure various resolution selections
   a. 16:9 aspect ratio : 1920 x 1080, 1280 x 720, 800 x 448, 640 x 360
   b. 4:3 aspect ratio : 1280 x 960, 1024 x 768, 800 x 600, 640 x 480, 320 x 240,
   c. 5:4 aspect ratio : 1280 x 1024, 720 x 576,
   d. 3:2 aspect ratio : 720 x 480,
4. The camera shall be able to stream at least 10 independent video stream type using unicast protocol
5. The camera shall support multicast and unicast video streaming
6. The camera shall be able to configure Dynamic DNS (DDNS).
7. Smart Codec, Dynamic GOV, and Dynamic fps to efficiently manage bitrate of the video stream.

B. Camera – The camera device shall have the following physical and performance properties:
   1. IK08 rated for protection against impacts.
   2. True day/night operation with removable IR cut filter
      a. Low light level operation to 0.055 lux at F2.0 in color mode and 0.0055 lux at F2.0 in black and white mode.

C. Intelligence and Analytics – The camera shall have a suite of integral intelligent operations and analytic functions to include:
   1. Motion detection with eight definable detection areas with 8 point polygonal zones, minimum / maximum object size.
   2. Detection of logical events of specified conditions from the camera's video input
      a. camera tamper (scene change)
      b. defocus detection
      c. fog detection
      d. motion detection with metadata
      e. face detection
      f. virtual area based event (intrusion, enter/exit, appear/disappear, loitering)
      g. virtual line based event (directional detection, crossing)
   3. Detection of logical events of specified conditions from the camera's audio input
      a. sound classification (scream, gunshot, explosion, crashing glass)

D. Interoperability – The camera shall be ONVIF Profile S and G compliant.

E. The camera shall possess the following further characteristics:
   1. Alarms and notifications
      a. alarm notification triggers:
         1.) motion detection
         2.) tampering detection
         3.) alarm input

4.) defocus detection
5.) fog detection
6.) face detection
7.) audio detection
8.) video & audio analytics
9.) network disconnection

b. available notification means upon trigger:
1.) file upload via FTP and e-mail
2.) notification via e-mail
3.) record to local storage (SD card) or NAS storage
4.) external output
5.) move to DPTZ preset

2. Pixel Counter available in the web viewer.
3. PoE capable

2.03 CAMERA SOFTWARE

A. The camera shall have a built in web server which supports browser-based configuration using Internet Explorer, Google Chrome, Mozilla Firefox, and Apple Safari from a PC or Mac.

B. The web viewer shall provide a monitoring screen which displays live camera video and simultaneously provides same-screen access to the following functions:
1. Live view window size
2. Resolution setting
3. Image (snapshot) capture
4. Manual recording to SD or NAS
5. Audio/microphone control
6. Access recorded data playback and camera configuration menus
7. Digital PTZ

C. The web viewer shall provide a playback screen which provides access to the following functions:
1. Recorded data search using date and time range
2. Recorded data search using event type
3. Play a recorded video by event triggering
4. Set resolution
5. Play audio if present
6. Generate a backup copy of saved video data

D. The web viewer shall provide a setup screen which provides access to the following configuration settings and functions in the camera:
1. Digital video profile to include compression type, maximum or target bit rate, frame rate, multicast parameters, crop encoding area
2. User profile to include password, access level, authentication
3. Date and time
4. Network settings and IP version

a. DDNS
b. SSL, including certificate management
c. 802.1x authentication
d. Quality of Service settings
e. SNMP to include version selection and settings
f. Auto configuration

5. Video setup to include flip and mirror mode, hallway view mode, video type, privacy zone
6. Audio setup to include source, audio codec type, gain, and bit rate
7. Camera settings to include image preset, sensor frame capture, dynamic range, white balance, back light, exposure, day/night operation, on-screen display, sharpness, contrast, color level, lens distortion correction.
8. Event detection setup to include notification parameters, recording rules, time schedule, tamper protection, motion detection, event triggers
9. System function to include reboot, upgrade, check system and event logs, application (SDK) management
10. View profile information

E. Client requirements
1. Acceptable Operating Systems: Windows 7 / 8.1 / 10, MAC OS X 10.10, 10.11, 10.12
2. Acceptable browsers: Microsoft Internet Explorer and Edge, Mozilla Firefox, Google Chrome, Apple Safari

2.04 DETAILED SPECIFICATIONS

A. Video
1. Imager
a. Sensor: 1/2.8" 2.16MP CMOS
1.) pixels per sensor: 1945 (H) x 1109(V) total; 1945 (H) x 1097 (V) effective
2.) scanning : progressive
b. Minimum illumination
1.) Color mode: 0.055Lux (F2.0, 30IRE)
2.) Black & white mode: 0.0055Lux (F2.0, 30IRE)
c. The following features with control settings shall be available:
1.) Camera Title Off / On (Displayed up to 85 characters per line)
a.) W/W: English / Numeric / Special characters
b.) China: English / Numeric / Special / Chinese characters
c.) Common: Multi-line (Max. 5), Color (Grey/Green/Red/Blue/Black/White),
Transparency, Auto scale by resolution
2.) Day/night setting: True Day & Night
3.) Backlight compensation (BLC): Off / BLC / HLC / WDR
4.) WDR 150dB

5.) Digital Noise Reduction (DNR): Off / On (Samsung Super Noise Reduction Ⅴ)

6.) Motion Detection: Off / On (8ea, 8point polygonal zones)

7.) Privacy Masking: Off / On (32ea, 4point polygonal zones)

8.) Gain Control: Off / Low / Middle / High

9.) White Balance: ATW / AWC / Manual / Indoor / Outdoor

10.) LDC: Off / On (5 levels with min / max)

11.) Electronic shutter speed:

a.) settings: min, max, anti-flicker (2 ~ 1/12,000sec)

12.) Image flip: Off / On

13.) Image mirror: Off / On

14.) Hallway view: 0°/90°/270°

15.) Alarm I/O: Input 1 / Output 1

16.) Alarm Triggers: Motion detection, Tampering detection, Alarm input, Fog detection, Defocus Detection, Face detection, Audio detection, Sound classification, Network disconnection, Intelligent video analytics.

17.) Alarm Events: File upload via FTP and E-mail, Local storage recording at event Notification via E-mail, External output, DPTZ preset

18.) Pixel Counter: Available in the web viewer.

d. Lens: 2.4 mm fixed manual

1.) Max. Aperture Ratio: F2.0

2.) Angle of view: H: 139.0° / V: 73.0° / D: 167.0°

3.) Focus Control: Manual

4.) Lens Type: Fixed

5.) Mount Type: Board-in Type

e. Manual positional settings:

a.) pan: 0° ~ 354°

b.) tilt: 0° ~ 67°

c.) rotation 0° ~ 355°

2. Video Streams

a. The camera shall be able to produce 10 video profiles, each of which may have the following properties:

1.) Encoding type:

a.) H.265

b.) H.264

c.) MJPEG

2.) Resolution: 1920 x 1080, 1280 x 1024, 1280 x 960, 1280 x 720, 1024 x 768,800 x 600, 800 x 448, 720 x 576, 720 x 480, 640 x 480, 640 x 360, 320 x 240

3.) Maximum frame rate:

a.) H.265 and H.264: 60 fps at all resolutions

b.) MJPEG: 30 fps at all resolutions

4.) Smart Codec WiseStream Ⅱ, Dynamic GOV, Dynamic fps

5.) Bit rate control method:

a.) H.265 and H.264

i. target bitrate level control

ii. constant bit rate (CBR) or variable bit rate (VBR)

b.) MJPEG

i. target bitrate level control

ii. variable bit rate (VBR)

3. Interoperability - Video streams shall be capable of supporting ONVIF protocol, profiles S and G.
4. Single Images - The camera shall support png file image screenshot and export.

B. Network

1. Connectivity: 10/100 Base-T Ethernet via RJ-45 connector
2. Protocols supported:
   a. Transmission Control Protocol (TCP), Internet Protocol (IP) v4 and v6, User Datagram Protocol (UDP)
   b. Configuration: Dynamic Host Configuration Protocol (DHCP)
   c. Web services: Hypertext Transfer Protocol (HTTP), Secure HTTP (HTTPS)
   d. Network services: Address Resolution Protocol (ARP), Bonjour, Domain Name System (DNS), Internet Control Message Protocol (ICMP), Network Time Protocol (NTP), Protocol Independent Multicast-Sparse Mode (PIM-SM), Simple Network Management Protocol (SNMP v1/2c/3 – MIB-2), Universal Plug and Play (UPnP)
   e. Media: Real-Time Transport Protocol (RTP), Real-Time Control Protocol, Real-Time Streaming Protocol (RTSP)
   f. Multicast: Internet Group Management Protocol (IGMP)
   g. Notifications: File Transfer Protocol (FTP), Simple Mail Transfer Protocol (SMTP)
   h. Remote Access: Point-to-Point Protocol over Ethernet) (PPPoE)
3. DDNS – The camera shall support DDNS services offered by the Manufacturer and other publicly available service offerings.
4. Quality of Service (QoS) – Layer 3 DSCP
5. Security features:
   a. user password protection
   b. IP address filtering - list of allowed or blocked IP addresses
   c. HTTPS(SSL) login authentication
   d. HTTPS(SSL) secured communications

e. Digest login authentication
f. User access log
g. 802.1x authentication

6. Discovery - Manufacturer shall offer a discovery program to identify all devices of his manufacture on the network.

C. Audio
1. Direction: bi-directional
2. I/O Mic-in / Line-in selectable, Line-out
3. Compression:
a. G.711 u-law/G.726/AAC-LC selectable
1.) G.726 (ADPCM) 8KHz, G.711 8KHz
2.) G.726: 16Kbps, 24Kbps, 32Kbps, 40Kbps
3.) AAC-LC: 48Kbps at 8/16/32/48HKz

D. Electrical
1. Power
a. Input Voltage / Current PoE (IEEE802.3af, Class3), 12V DC
b. Power Consumption: <6 W (PoE), <5.5 W (12V DC)

E. Mechanical And Environmental
1. Material:
a. Housing: Metal
2. Dimensions (W x H): 110.0 x 90.0 mm (4.33 x 3.54 in.).
3. Weight 365g (0.80 lb.)
4. Temperature:
a. Operating: -10° C to 55° C (+14° F to 131° F)
b. Storage: -50° C to 60° C (-58° F to 140° F)
5. Humidity: 0 ~ 90%, non-condensing
6. Environmental Rating:
a. Mechanical (Vandal) Protection

PART 3 EXECUTION

3.01 INSTALLERS

A. Contractor personnel shall comply with all applicable state and local licensing requirements.

3.02 PREPARATION

A. The network design and configuration shall be verified for compatibility and performance with the camera(s).

B. Network configuration shall be tested and qualified by the Contractor prior to camera installation.

C. All equipment shall be tested and configured in accordance with instructions provided by the manufacturer prior to installation.

D. All firmware found in products shall be the latest and most up-to-date provided by the manufacturer, or of a version as specified by the provider of the Video Management Application (VMA).

E. All equipment requiring users to log on using a password shall be configured with user/site-specific password/passwords. No system/product default passwords shall be allowed.

3.03 INSTALLATION

A. The Contractor shall carefully follow instructions in documentation provided by the manufacturer to insure all steps have been taken to provide a reliable, easy-to-operate system.

B. All software shall be tested and configured in accordance with instructions provided by the manufacturer prior to installation.

C. Before permanent installation of the system, the Contractor shall test the system in conditions simulating the final installed environment.

3.04 STORAGE

A. The hardware shall be stored in an environment where temperature and humidity are in the range specified by the Manufacturer.

DEVICE MANAGER
PRODUCTS

3.05 EQUIPMENT

A. Manufacturer: Hanwha Techwin
http://www.hanwha-security.com/

B. Model Device Manager

C. Alternates: None

3.06 GENERAL DESCRIPTION

A. The software shall provide an efficient way to manage Hanwha Techwin video surveillance devices in network including IP cameras, encoders, decoders, NVRs and DVRs by enabling users to remotely configure multiple devices simultaneously.

B. The software shall search for Hanwha Techwin network devices in the same network, with a selectable search duration ranging from 5 – 60 seconds. The search results are available in the following modes.

1. Icons view with live image, model name, device status, device name, MAC address, IP address
2. List view with live image, model name, device status, device name, IP mode, IP address, MAC address, firmware version, firmware status, ISP version
3. Detail view with model name, device status, device name, IP mode, IP address, MAC address, firmware version, firmware status, ISP version, motion board version, serial number, IP version, last refresh time

C. The software shall provide live viewer for cameras with valid credentials. Live viewer shall include the following.

1. Live streaming of up to four cameras or of up to four profiles from one camera.
2. Device information

a. Device name
b. MAC address
c. IP address
d. HTTP port
e. Device port
f. Resolution
g. Profile number
h. Display in original size
i. Keep aspect ratio
j. Snapshot to save images in JPEG format.

3. PTZ control
   a. Pan/Tilt/Zoom control
   b. Sensitivity of PTZ control
   c. Move to a position set in coordinate with zoom ratio set by user
   d. Add and delete preset
   e. Move to home position
4. Focus setup
   a. Adjust focus
   b. Zoom control
   c. Simple focus
5. Status of profiles
   a. Profile number
   b. Current bitrate in kbps with graph. Graph shall adjust automatically based on bitrate and
   c. Current frame rate in fps with graph. Graph shall also include information on I and P frames.
   d. ATC in percentage
   e. Number of users accessing each profile
6. Status of current users
   a. Profile the user is accessing
   b. IP address of users
   c. Bitrate
   d. Connection status

D. The software shall support manually adding devices in LAN/WAN network environments individually or by including/excluding IP address(es)/ranges.

E. The software shall support changing the name setting stored in a camera/encoder.

F. The software shall support changing IP address information including: IP address mode, IP address/range, subnet mask, default gateway, DNS, HTTP port, device port, & RTSP port. The software shall provide a simulation to display previous and new IP address before applying changes.

G. The software shall support manually entering of user credentials for one or more device as well as auto log in with credential set by users. The software shall support changing IP camera/encoder admin password, requiring a complex password.

H. The software shall support checking device status including login status, name, IP address, MAC address, firmware version, serial number, and refreshing image snapshot. The software shall display device status including Login OK, Login Fail, Connect Fail, & Ready.

I. The software shall support checking the status of firmware without the need for cameras to be directly internet accessible.

J. The software shall support the download and upgrade of firmware on multiple devices. Upgrade shall support sequential or parallel upgrading of 16 simultaneous cameras, queuing additional devices. The software shall support downloading firmware by selected model, series, and searched devices. Downloaded firmware shall be automatically extracted and selection of the latest version. The software shall support manual selection of firmware including the ability to downgrade versions. A warning shall be provided in special cases requiring additional attention. Firmware upgrade status shall be displayed in addition to initial and new version. The software shall support upgrading firmware at a specified relative or absolute time. The software shall support performing an automatic download and upgrade procedure.

K. The software shall support updating the clock on cameras by manual entry, one-time sync from PC, or NTP server. The software shall support entry of up to 5 NTP server addresses. The software shall support the entry of daylight savings Time mode and time zone selection.

L. The software shall support backing up and restoring configuration data from multiple cameras. Backup file name shall include model number, IP address, and MAC address, and shall be user editable. Backup and restore shall be performed in parallel or sequential mode, and at a user desired relative or absolute time. The software shall support restoring a single configuration to multiple devices.

M. The software shall support configuration of video profiles of multiple cameras by model. Video profiles shall be deleted, added, and renamed. Configuration options shall include megapixel mode, codec, default profile, e-mail/FTP profile, record profile, resolution, frame rate, compression, bitrate, bitrate control mode, encoding priority, GOP size, H.264 profile, & entropy encoding. The software shall allow display of current settings and status results.

N. The software shall support sending the following commands to multiple cameras selectable by model: analog video out on/off for installers, analog video out status, factory reset, reboot, sensor mode, sensor mode status, language, mirror mode, image flip, video profile connection policy, simple focus, & delete profile 10. The software shall display the result of each command.

O. The software shall support sending user-entered CGI commands to multiple cameras selectable by model. The software shall display the result of each command and the response received.

P. The software shall support creating and running a script to create and delete profile settings and logging bitrate data. The software shall support saving/loading scripts, displaying live video results, and exporting results to JPEG & CSV log files.

Q. The software shall support save/loading device information to an encrypted XML file, with optional password protection.

R. The software shall allow viewing and deleting of the ARP table.

S. The software shall support displaying live video of a searched network device, including profile selection, I/P frame, connected clients, snapshot, PTZ control, preset display/set, and bitrate display. Information display shall include display per profile, per user, bitrate graph, and frame rate graph. PTZ controls shall include pan, tilt, zoom, speed, focus, absolute position get & move, preset save & move, delete, delete all, home save & move. Focus controls shall include zoom/focus adjustments by increments of 1, 10, 100, and simple focus. Up to 4 cameras/streams shall be able to be displayed at one time in separate windows.

T. The software shall setup of multicast setting for a specified video profile, allowing automatic calculation of sequential port or IP address based on entered starting value. Results shall be shown prior to configuration changes.

U. The software shall enable users to change camera settings including noise reduction, white balance, back light compensation, exposure, day and night settings, and etc.

V. The software shall support setup of motion detection settings including enable, disable, and sensitivity.

W. The software shall support creating a report in Excel or CVS format, with selectable fields including profiles, event setup, system, & camera snapshot (Excel format only). System fields shall include IP address, serial number, MAC address, ports, firmware version, & current time/date. Microsoft Excel shall be installed on PC in advance by user in order for Excel report to be created.

X. The software shall support setup of open SDK settings, including view of firmware and open platform version, install application, start/stop/uninstall application, set application priority level & auto start, and license file installation.

Y. The software shall support setup of audio settings including audio input (source, microphone power, codec, bitrate, gain) & audio output (enable/disable, gain).

Z. The software shall support setup of SSL settings including disable, enable with a public certificate, enable with a unique certificate, loading of certificate file, loading of key file, installation & deletion.

AA. The software shall support setup of SNMP settings including Enable SNMP v1, SNMP v2c (read/write community), SNMP v3 (password), SNMP Trap (community, IP address, authentication failure, & network connection).

BB. The software shall support exporting device logs including system, access, & event logs.

CC. The software shall support setting camera image menu adjustments including SSDR, white balance, backlight compensation, exposure, day/night, special, & OSD. Image adjustments shall be performed and displayed on a selected camera immediately, and to other selected cameras per model upon selection.

DD. The software shall support setup of 802.1x settings including enable, EAPOL version, ID & password, install/delete CA certificate, install/delete client certificate, & install/delete client private key.

EE. The software shall support an optional password to restrict access upon startup.

FF. The software shall display devices by Icon view, List View, & Detailed View. Icon view and List view shall display a static snapshot. Detailed view shall allow sorting by any field. The software shall support filtering by device type, status, & model number.

GG. The software shall support creating named Bookmarks to logically group devices. Bookmarks shall be saved in a project file. Devices shall be allocated to bookmarks by dragging them to the bookmark name.

HH. The software shall support a status monitor function to monitor the status of devices at a set interval, providing popup notification of disconnected devices and logging. Status monitoring interval and log duration shall be user selectable. The software shall feature a log display function with calendar date selection. The log display shall include firmware upgrade, configuration backup/restore, restart, factory default, & status change. The status monitor function shall allow the software to run in the system tray, even upon closing the software. The tray icon allows access to the software as well as changing status monitor on/off.

II. The software shall feature an auto-update check/notification using the Online Updater Utility, if connected to the Internet. The Online Updater shall check for a new version of Device Manager & Online Updater on each execution of the software. The Online Updater shall be installed automatically with the Device Manager. The Online Updater shall also allow installation of the Device Manager software.

JJ. The software shall display network adapters, connection status & IP address. The software shall allow the selection of a specific IP address to enable for use.

KK. The software shall include a user manual access through the help menu, including version release history.

LL. The software shall support entry of default credentials to be used with searched devices.

MM. The software shall support selecting the default web browser. The software shall support access to device web page in the selected default web browser by double-click of device entry in list.

NN. The software shall support password setup for device manager.

OO. The software shall be able to reset its settings to defaults when requested.

PP. The software shall support a network diagnostic function utilizing selected devices or manually entered IP address/range and ports. The diagnostic functional shall allow entry of packet size and packet fragmentation. The display shall include continuous ping with TTL, round trip time, hop count, and trace route.

QQ. The software shall provide an online updater which can check the version status of device manger and start update to the latest version.

3.07 DETAILED SPECIFICATIONS

A. System Requirement

1. Operating System (Support 64-bit OS) — Windows XP, Windows Vista, Windows 7, 8, 8.1, 10

2. Platform Requirement (included in installation package)

   a. Microsoft .NET Framework 4 Client Profile

   b. Microsoft Visual C++ 2010 Redistributable Package (x86)

3. CPU — Pentium III CPU 1GHz or higher

4. Graphic card — XGA (800x600) video graphic card

B. Language

1. Supported Language — English, Korean, Japanese, Chinese, Polish, Italian, Rumanian, French, Spanish, Turkish, German, Czech

C. Supported Device — Hanwha Techwin Video Surveillance Devices

SECTION 28 3111
FIRE DETECTION AND ALARM SYSTEM

PART 1 GENERAL

1.01 RELATED SECTIONS

A. Section 27 1500 Communications Horizontal Cabling

1.02 DESCRIPTION

A. The fire alarm system shall comply with requirements of NFPA Standard 72 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 facility shall have an emergency voice alarm communication system. Digitally stored message sequences shall notify the building occupants that a fire or life safety condition has been reported. Message generator(s) shall be capable of automatically distributing up to eight (8) simultaneous, unique messages to appropriate audio zones within the facility based on the type and location of the initiating event. The Fire Command Center (FCC) shall also support Emergency manual voice announcement capability for both system wide or selected audio zones, and shall include provisions for the system operator to override automatic messages system wide or in selected zones.

C. The system shall be support additional, alternate Fire Command Centers, which shall be capable of simultaneous monitoring of all system events. Alternate Fire Command Centers shall also support an approved method of transferring the control functions to an alternate Fire Command Center when necessary. All Fire Command Centers shall be individually capable of assuming Audio Command functions such as Emergency Paging, audio zone control functions, and Firefighter's Telephone communication functions.

D. Each designated zone shall transmit separate and different alarm, supervisory and trouble signals to the Fire Command Center (FCC) and designated personnel in other buildings at the site via a multiplex communication network.

E. 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

F. The FACP and peripheral devices shall be manufactured 100% by a single U.S. manufacturer (or division thereof). It’s acceptable for peripheral devices to be manufactured outside of the U.S. by a division of the U.S. based parent company.

G. 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 installion shall be in compliance with the UL listing.

H. 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.

1.03 SCOPE

A. A new intelligent reporting, microprocessor controlled fire detection system shall be installed in accordance to the project specifications and drawings.

B. Basic Performance:

1. Alarm, trouble and supervisory signals from all intelligent reporting devices shall be encoded on NFPA Style 4 (Class B) Signaling Line Circuits (SLC).

2. Device Circuits (IDC) shall be wired Class A (NFPA Style D) as part of an addressable device connected by the SLC Circuit.

3. Notification Appliance Circuits (NAC) shall be wired Class A (NFPA Style Z) as part of an addressable device connected by the SLC Circuit.

4. On Style 6 or 7 (Class A) configurations a single ground fault or open circuit on the system Signaling Line Circuit shall not cause system malfunction, loss of operating power or the ability to report an alarm.

5. Alarm signals arriving at the FACP shall not be lost following a primary power failure (or outage) until the alarm signal is processed and recorded.

6. Speaker circuits may be controlled by NAC outputs built into the amplifiers, which shall function as addressable points on the Digital Audio Loop.

7. NAC speaker circuits shall be arranged such that there is a minimum of one speaker circuit per floor of the building or smoke zone which ever is greater.

8. Audio amplifiers and tone generating equipment shall be electrically supervised for normal and abnormal conditions.

9. NAC speaker circuits and control equipment shall be arranged such that loss of any one (1) speaker circuit will not cause the loss of any other speaker circuit in the system.

   Two-way emergency telephone communication circuits shall be supervised for open and short circuit conditions.

   Speaker circuits shall be arranged such that there is a minimum of one speaker circuit per smoke zone.

   Speaker circuits shall be electrically supervised for open and short circuit conditions. If a short circuit exists on a speaker circuit, it shall not be possible to activate that circuit.

10. Audio amplifiers and tone generating equipment shall be electrically supervised for abnormal conditions. Digital amplifiers shall provide built-in speaker circuits, field configurable as four Class B (Style Y), or two Class A (Style Z) circuits.

11. Digital amplifiers shall be capable of storing up to two minutes of digitally recorded audio messages and tones. The digital amplifiers shall also be capable of supervising the connection to the associated digital message generator, and upon loss of that connection shall be capable of one of the following system responses:

    a. The digital amplifier shall automatically broadcast the stored audio message.

    b. The digital amplifier shall switch to a mode where a local bus input on the digital amplifier will accept an input to initiate a broadcast of the stored message. This bus input shall be connected to a NAC on a local FACP for the purpose of providing an alternate means of initiating an emergency message during a communication fault condition.

    c. Speaker circuits shall be either 25 VRMS or 70VRMS. Speaker circuits shall have 20% space capacity for future expansion or increased power output requirements.

    d. Two-way emergency telephone (Fire Fighter Telephone) communication shall be supported between the Audio Command Center and up to seven (7) remote Fire Fighter's Telephone locations simultaneously on a telephone riser.

    e. Means shall be provided to connect FFT voice communications to the speaker circuits in order to allow voice paging over the speaker circuit from a telephone handset.

    f. The digital audio message generator shall be of reliable, non-moving parts, and support the digital storage of up to 32 minutes of tones and emergency messages, shall support programming options to string audio segments together to create up to 1000 messages, or to loop messages and parts of messages to repeat for pre-determined cycles or indefinitely.

1.04 GUARANTY:

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.

1.05 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.

B. As part of the bid/proposal, include a quote for a maintenance contract to provide all maintenance, required tests, and list pricing for any replacement products included on the bill of materi-

als, along with the list pricing for products not on the bill of materials; if test and inspection rates are different than full service rates the bid/proposal shall include pricing for all levels for a minimum period of five (5) years Rates and costs shall be valid for the period of five (5) years after expiration of the guaranty.

C. Include also a quote for unscheduled maintenance/repairs, including hourly rates for technicians trained on this equipment, and response travel costs for each year of the maintenance period. Submittals that do not identify all post contract maintenance costs will not be accepted. Rates and costs shall be valid for the period of five (5) years after expiration of the guaranty.

1.06 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. 12A	Halon 1301 Extinguishing Systems
No. 13	Sprinkler Systems
No. 15	Water Spray Systems
No. 16	Foam / Water Deluge and Spray Systems
No. 17	Dry Chemical Extinguishing Systems
No. 17A	Wet Chemical Extinguishing Systems
No. 2001	Clean Agent Extinguishing Systems
No. 70	National Electric Code
No. 90A	Air Conditioning Systems
No. 92A	Smoke Control Systems
No. 92B	Smoke Management Systems in Malls, Atria, Large Areas
No. 72	National Fire Alarm Code
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. 2572	Mass Notification 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).

1.07 APPROVALS:

A. The system shall have proper listing and/or approval from the following nationally recognized agencies:

UL	Underwriters Laboratories, Inc
ULC	Underwriters Laboratories Canada
FM	Factory Mutual
FM 6320	Factory Mutual Gas Detection System
NYFD	New York Fire Department
CSFM	California State Fire Marshal

B. The system shall be certified for seismic applications in accordance with the International Building Code (IBC). For OSHPD applications in California the system shall be Pre-Approved for seismic applications. The basis for qualification of seismic approval shall be via shake table testing.

C. The system shall be approved for Marine Applications and carry the following certifications:

1. USCG United States Coast Guard
2. Lloyd's Register
3. ABS American Bureau of Shipping

D. The System shall be FM 6320 (Factory Mutual) approved as a Gas Detection system when employed with the FMM-4-20 monitor module and industry standard 4-20 mA gas detectors.

PART 2 PRODUCTS

2.01 MAIN FIRE ALARM CONTROL PANEL OR NETWORK NODE:

A. Main FACP or network node shall be a NOTIFIER Model NFS2-3030 and shall contain a microprocessor based Central Processing Unit (CPU) and power supply. 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.

B. In conjunction with intelligent Loop Control Modules and Loop Expander Modules, the main FACP shall perform the following functions:

1. Supervise and monitor all intelligent addressable detectors and monitor modules connected to the system for normal, trouble and alarm conditions.
2. Supervise all initiating signaling and notification circuits throughout the facility by way of connection to addressable monitor and control modules.
3. Detect the activation of any initiating device and the location of the alarm condition. Operate all notification appliances and auxiliary devices as programmed. In the event of CPU failure, all SLC loop modules shall fallback to degrade mode. Such degrade mode shall treat the corresponding SLC loop control modules and associated detection devices as conventional two-wire operation. Any activation of a detector in this mode shall automatically activate associated Notification Appliance Circuits.

2.02 SYSTEM CAPACITY AND GENERAL OPERATION

A. The FACP shall be capable of communicating on Noti-Fire-Net over a Local Area Network (LAN) or Wide Area Network (WAN) utilizing a peer-to-peer, inherently regenerative communication

format and protocol. The network shall support communication speed up to 100 Mb and support up to 200 panels / nodes per network.

B. The control panel shall be capable of expansion via up to 10 SLC loops. Each module shall support up to 318 analog/addressable devices for a maximum system capacity of 3180 points. The Fire Alarm Control Panel shall include a full featured operator interface control and annunciation panel that shall include a backlit 640-character liquid crystal display, individual, color coded system status LEDs, and a keypad for the control of the fire alarm system. Said LCD shall also support graphic bit maps capable of displaying the company name and logo of either thpany.

C. All programming or editing of the existing program in the system shall be achieved without interrupting the alarm monitoring functions of the fire alarm control panel.

D. The FACP shall be able to provide the following software and hardware features:

1. Pre-signal and Positive Alarm Sequence: The system shall provide means to cause alarm signals to only sound in specific areas with a delay of the alarm from 60 to up to 180 seconds after start of alarm processing. In addition, a Positive Alarm Sequence selection shall be available that allows a 15-second time period for acknowledging an alarm signal from a fire detection/initiating device. If the alarm is not acknowledged within 15 seconds, all local and remote outputs shall automatically activate immediately.
2. Smoke Detector Pre-alarm Indication at Control Panel: To obtain early warning of incipient or potential fire conditions, the system shall support a programmable option to determine system response to real-time detector sensing values above the programmed setting. Two levels of Pre-alarm indication shall be available at the control panel: alert and action.
3. Alert: It shall be possible to set individual smoke detectors for pre-programmed pre-alarm thresholds. If the individual threshold is reached, the pre-alarm condition shall be activated.
4. Action: If programmed for Action and the detector reaches a level exceeding the pre-programmed level, the control panel shall indicate an action condition. Sounder bases installed with either heat or smoke detectors shall automatically activate on action Pre-Alarm level, with general evacuation on Alarm level.
5. The system shall support a detector response time to meet world annunciation requirements of less than 3 seconds.
6. Device Blink Control: Means shall be provided to turn off detector/module LED strobes for special areas.
7. NFPA 72 Smoke Detector Sensitivity Test: The system shall provide an automatic smoke detector test function that meets the sensitivity testing requirements of NFPA 72.
8. Programmable Trouble Reminder: The system shall provide means to automatically initiate a reminder that troubles exist in the system. The reminder will appear on the system display and (if enabled) will sound a piezo alarm.
9. On-line or Off-line programming: The system shall provide means to allow panel programming either through an off-line software utility program away from the panel or while connected and on-line. The system shall also support upload and download of programmed database and panel executive system program to a Personal Computer/laptop. A single change to one CPU database shall not require a database download to other CPUs.
10. History Events: The panel shall maintain a history file of the last 4000 events, each with a time and date stamp. History events shall include all alarms, troubles, operator actions, and programming entries. The control panels shall also maintain a 1000 event Alarm History buffer, which consists of the 1000 most recent alarm events from the 4000 event history file.
11. Smoke Control Modes: The system shall provide means to perform FSCS mode Smoke Control to meet NFPA-92A and 90B and HVAC mode to meet NFPA 90A.
12. The system shall provide means for all SLC devices on any SLC loop to be auto programmed into the system by specific address. The system shall recognize specific device type ID's and associate that ID with the corresponding address of the device.

13. Passwords and Users: The system shall support two password levels, master and user. Up to 9 user passwords shall be available, each of which may be assigned access to the programming change menus, the alter status menus, or both. Only the master password shall allow access to password change screens.
14. Block Acknowledge: The system shall support a block Acknowledge for Trouble Conditions
15. Sensitivity Adjust: The system shall provide Automatic Detector Sensitivity Adjust based on Occupancy schedules including a Holiday list of up to 15 days.
16. Environmental Drift Control: The system shall provide means for setting Environmental Drift Compensation by device. When a detector accumulates dust in the chamber and reaches an unacceptable level but yet still below the allowed limit, the control panel shall indicate a maintenance alert warning. When the detector accumulates dust in the chamber above the allowed limit, the control panel shall indicate a maintenance urgent warning.
17. Custom Action Messages: The system shall provide means to enter up to 100 custom action messages of up to 160 characters each. It shall be possible to assign any of the 100 messages to any point.
18. Local Mode: If communication is lost to the central processor the system shall provide added survivability through the intelligent loop control modules. Inputs from devices connected to the SLC and loop control modules shall activate outputs on the same loop when the inputs and outputs have been set with point programming to participate in local mode or when the type codes are of the same type: that is, an input with a fire alarm type code shall activate an output with a fire alarm type code.
19. Read status preview - enabled and disabled points: Prior to re-enabling points, the system shall inform the user that a disabled device is in the alarm state. This shall provide notice that the device must be reset before the device is enabled thereby avoiding activation of the notification circuits.
20. Custom Graphics: When fitted with an LCD display, the panel shall permit uploading of a custom bit-mapped graphic to the display screen.
21. Multi-Detector and Cooperating Detectors: The system shall provide means to link one detector with up to two detectors at other addresses on the same loop in cooperative multi-detector sensing. There shall be no requirement for sequential addresses on the detectors and the alarm event shall be a result ofall cooperating detectors chamber readings.
22. ACTIVE EVENT: The system shall provide a Type ID called FIRE CONTROL for purposes of air-handling shutdown, which shall be intended to override normal operating automatic functions. Activation of a FIRE CONTROL point shall cause the control panel to (1) initiate the monitor module Control-by-Event, (2) send a message to the panel display, history buffer, installed printer and annunciators, (3) shall not light an indicator at the control panel, (4) Shall display ACTIVE on the LCD as well a display a FIRE CONTROL Type Code and other information specific to the device.
23. NON-FIRE Alarm Module Reporting: A point with a type ID of NON-FIRE shall be available for use for energy management or other non-fire situations. NON-FIRE point operation shall not affect control panel operation nor shall it display a message at the panel LDC. Activation of a NON-FIRE point shall activate control by event logic but shall not cause any indication on the control panel.
24. Mass Notification Override:The system shall be UL 2572 listed for Mass Notification and shall be capable, based on the Risk Analysis, of being programmed so that Mass Notification/Emergency Communications events take precedence over fire alarm events.
25. Security Monitor Points: The system shall provide means to monitor any point as a type security.
26. One-Man Walk Test: The system shall provide both a basic and advanced walk test for testing the entire fire alarm system. The basic walk test shall allow a single operator to run audible tests on the panel. All logic equation automation shall be suspended during the test and while annunciators can be enabled for the test, all shall default to the disabled

state. During an advanced walk test, field-supplied output point programming will react to input stimuli such as CBE and logic equations. When points are activated in advanced test mode, each initiating event shall latch the input. The advanced test shall be audible and shall be used for pull station verification, magnet activated tests on input devices, input and output device and wiring operation/verification.

27. Control By Event Functions: CBE software functions shall provide means to program a variety of output responses based on various initiating events. The control panel shall operate CBE through lists of zones. A zone shall become listed when it is added to a point's zone map through point programming. Each input point such as detector, monitor module or panel circuit module shall support listing of up to 10 zones into its programmed zone map.
28. Permitted zone types shall be general zone, releasing zone and special zone. Each output point (control module, panel circuit module) can support a list of up to 10 zones including general zone, logic zone, releasing zone and trouble zone. It shall be possible for output points to be assigned to list general alarm. Non-Alarm or Supervisory points shall not activate the general alarm zone.
29. 1000 General Zones: The system shall support up to 1000 general purpose software zones for linking inputs to outputs. When an input device activates, any general zone programmed into that device's zone map will be active and any output device that has an active general zone in its map will be active. It shall also be possible to use general zone as arguments in logic equations.
30. 1000 Logic Equations: The system shall support up to 1000 logic equations for AND, OR, NOT, ONLY1, ANYX, XZONE or RANGE operators that allow conditional I/O linking. When any logic equation becomes true, all output points mapped to the logic zone shall activate.
31. 100 trouble equations per device: The system shall provide support for up to 100 trouble equations for each device, which shall permit programming parameters to be altered, based on specific fault conditions. If the trouble equation becomes true, all output points mapped to the trouble zone shall activate.
32. Control-By-Time: A time based logic function shall be available to delay an action for a specific period of time based upon a logic input with tracking feature. A latched version shall also be available. Another version of this shall permit activation on specific days of the week or year with ability to set and restore based on a 24 hour time schedule on any day of the week or year.
33. 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.
34. Alarm Verification, by device, with timer and tally: The system shall provide a user-defined global software timer function that can be set for a specific detector. The timer function shall delay an alarm signal for a user-specified time period and the control panel shall ignore the alarm verification timer if another alarm is detected during the verification period. It shall also be possible to set a maximum verification count between 0 and 20 with the "0" setting producing no alarm verification. When the counter exceeds the threshold value entered, a trouble shall be generated to the panel.

E. Network Communication

1. The FACP shall be capable of communicating on Noti-Fire-Net over a Local Area Network (LAN) or Wide Area Network (WAN) utilizing a peer-to-peer, inherently regenerative communication format and protocol. The network shall support communication speed up to 100 Mb and support up to 200 panels/nodes per network.

F. Central Processing Unit

1. The Central Processing Unit shall contain and execute all control-by-event (including Boolean functions including but not limited to AND, OR, NOT, ANYx, and CROSSZONE) programs for specific action to be taken if an alarm condition is detected by the system. Such

control-by-event programs shall be held in non-volatile programmable memory, and shall not be lost with system primary and secondary power failure.

2. The Central Processing Unit shall also provide a real-time clock for time annotation, to the second, of all system events. The time-of-day and date shall not be lost if system primary and secondary power supplies fail.

3. The CPU shall be capable of being programmed on site without requiring the use of any external programming equipment. Systems that require the use of external programmers or change of EPROMs are not acceptable.

4. The CPU shall provide an EIA-232 interface between the fire alarm control panel and the UL Listed Electronic Data Processing (EDP) peripherals.

5. The CPU shall provide two EIA-485 ports for the serial connection to annunciation and control subsystem components.

6. The EIA-232 serial output circuit shall be optically isolated to assure protection from earth ground.

G. Display

1. The system display shall provide a 640-character backlit alphanumeric Liquid Crystal Display (LCD). It shall also provide eleven Light-Emitting-Diodes (LEDs) that indicate the status of the following system parameters: AC POWER, FIRE ALARM, PREALARM, SECURITY, SUPERVISORY, SYSTEM TROUBLE, OTHER EVENT, SIGNALS SILENCED, POINT DISABLED, CONTROLS ACTIVE, and CPU FAILURE.

2. The system display shall provide a keypad with control capability to command all system functions, entry of any alphabetic or numeric information, and field programming. Two different password levels with up to ten (one Master and nine User) passwords shall be accessible through the display interface assembly to prevent unauthorized system control or programming.

H. Loop (Signaling Line Circuit) Control Module:

1. The Loop Control Module shall monitor and control a minimum of 318 intelligent addressable devices. This includes 159 intelligent detectors (Ionization, Photoelectric, or Thermal) and 159monitor or control modules.

2. The Loop Control Module shall contain its own microprocessor and shall be capable of operating in a local/degrade mode (any addressable device input shall be capable of activating any or all addressable device outputs) in the unlikely event of a failure in the main CPU.

3. Each Loop shall be capable of operating as a NFPA Style 4 (Class B) circuit.

4. The SLC interface board shall receive analog or digital information from all intelligent detectors and shall process this information to determine whether normal, alarm, or trouble conditions exist for that particular device. Each SLC Loop shall be isolated and equipped to annunciate an Earth Fault condition. The SLC interface board software shall include software to 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 may also be used for automatic detector testing and the automatic determination of detector maintenance requirements.

I. Digital Voice Command Center

1. The Digital Voice Command Center located with the FACP, shall contain all equipment required for all audio control, emergency telephone system control, signaling and supervisory functions. This shall include speaker zone indication and control, telephone circuit indication and control, digital voice units, microphone and main telephone handset.

2. Function: The Voice Command Center equipment shall perform the following functions:

a. Operate as a supervised multi-channel emergency voice communication system.

Operate as a two-way emergency telephone system control center.

b. Audibly and visually annunciate the active or trouble condition of every speaker cir-

cuit and emergency telephone circuit.

c. Audibly and visually annunciate any trouble condition for digital tone and voice units required for normal operation of the system.

d. Provide all-call Emergency Paging activities through activation of a single control switch.

e. As required, provide vectored paging control to specific audio zones via dedicated control switches.

f. Provide a factory recorded "library" of voice messages and tones in standard WAV. File format, which may be edited and saved on a PC running a current Windows® operating system.

g. Provide a software utility capable of off-line programming for the DVC operation and the audio message files. This utility shall support the creation of new programs as well as editing and saving existing program files. Uploading or downloading the DVC shall not inhibit the emergency operation of other nodes on the fire alarm network.

h. Support an optional mode of operation with four analog audio outputs capable of being used with UL 864 fire-listed analog audio amplifiers and SLC controlled switching.

i. The Digital Voice Command shall be modular in construction, and shall be capable of being field programmable without requiring the return of any components to the manufacturer and without requiring use of any external computers or other programming equipment.

j. The Digital Voice Command and associated equipment shall be protected against unusually high voltage surges or line transients.

J. Power Supply:

1. The Main Power Supply shall operate on 120/240 VAC, 50/60 Hz, and shall provide all necessary power for the FACP.

2. The Main Power Supply shall provide the required power to the CPU using a switching 24 VDC regulator and shall incorporate a battery charger for 24 hours of standby power using dual-rate charging techniques for fast battery recharge.

3. The Main Power Supply shall provide a battery charger for 24 hours of standby using dual-rate charging techniques for fast battery recharge. The supply shall be capable of charging batteries ranging in capacity from 7-200 amp-hours within a 48-hour period.

4. The Main Power Supply shall provide a very low frequency sweep earth detect circuit, capable of detecting earth faults.

5. The Main Power Supply shall be power-limited per UL864 requirements.

6. The Main Power Supply shall communicate power supply, line voltage, battery status and charger status to the local LCD display. Any abnormal condition shall be annunicated and logged to the system alarm history log.

7. Addressable Charger Power SupplyThe auxiliary addressable power supply is a remote 24 VDC power supply used to power Notification Devices and field devices that require regulated 24 VDC power. . NOTIFIER model # ACPS-610

8. The addressable power supply for the fire detection system shall provide up to a minimum of 6.0 amps of 24 volt DC regulated power for Notification Appliance Circuit (NAC) power or 10.0 amps of 24 volt DC general power. The power supply shall have an additional 0.5 amp of 24 VDC auxiliary power for use within the same cabinet as the power supply. It shall include an integral charger designed to charge 12 - 200 amp hour batteries.

9. The addressable power supply shall provide four individually addressable Notification Appliance Circuits that may be configured as Class "A" or Class "B" circuits. All circuits shall be power-limited per UL 864 requirements.

10. The addressable power supply shall provide built-in synchronization for certain Notification

Appliances on each circuit without the need for additional synchronization modules. The power supply's output circuits shall be individually selected for synchronization. A single addressable power supply shall be capable of supporting both synchronized and non-synchronized Notification Devices at the same time.

11. The addressable power supply shall operate on 120 or 240 VAC, 50/60 Hz.
12. The interface to the power supply from the Fire Alarm Control Panel (FACP) shall be via the Signaling Line Circuit (SLC) or other multiplexed means Power supplies that do not use an intelligent interface are not suitable substitutes. The required wiring from the FACP to the addressable power supply shall be a single unshielded twisted pair wire.
13. The addressable power supply shall supervise for battery charging failure, AC power loss, power brownout, battery failure, NAC loss, and optional ground fault detection. In the event of a trouble condition, the addressable power supply shall report the incident and the applicable address to the FACP via the SLC.
14. The addressable power supply shall have an AC Power Loss Delay option. If this option is utilized and the addressable power supply experiences an AC power loss, reporting of the incident to the FACP will be delayed. A delay time of zero, two, eight or sixteen hours shall be programmable.
15. The addressable power supply shall have an option for Canadian Trouble Reporting and this option shall be programmable.
16. The addressable power supply mounts in either the FACP backbox or it's own dedicated surface mounted backbox with cover.
17. Each of the power supply's four output circuits shall be programmed- for Notification Appliance Circuit or General Purpose 24 VDC power. Any output circuit shall be able to provide up to 2.5 amps of 24 VDC power.
18. The addressable power supply's output circuits shall be individually supervised when they are selected to be either a Notification Appliance Circuit when wired Class "A" or by the use of and end-of-line resistor. When the power supply's output circuit is selected as General 24 VDC power, the circuit shall be individually supervised when an end-of-line relay is used.
19. When selected for Notification Appliance Circuits, the output circuits shall be individually programmable for Steady, March Time, Dual Stage or Temporal.
20. When selected as a Notification Appliance Circuit, the output circuits of the addressable power supply shall have the option to be coded by the use of a universal zone coder.
21. The addressable power supply shall interface and synchronize with other power supplies of the same type. The required wiring to interface multiple addressable power supplies shall be a single unshielded, twisted pair wire.
22. An individual or multiple interfaced addressable power supplies shall have the option to use an external charger for battery charging. Interfaced power supplies shall have the option to share backup battery power.

K. Audio Amplifiers

1. The Audio Amplifiers will provide Audio Power () for distribution to speaker circuits.
2. Multiple audio amplifiers may be mounted in a single enclosure, either to supply incremental audio power, or to function as an automatically switched backup amplifier(s).
3. The audio amplifier shall include an integral power supply, and shall provide built-in LED indicators for the following conditions:
    a. Earth Fault on DAP A (Digital Audio Port A)
    b. Earth Fault on DAP B (Digital Audio Port B)
    c. Audio Amplifier Failure Detected Trouble
    d. Active Alarm Bus input

e. Audio Detected on Aux Input A
f. Audio Detected on Aux Input B
g. Audio Detected on Firefighter's Telephone Riser
h. Receiving Audio from digital audio riser
i. Short circuit on speaker circuit 1
j. Short circuit on speaker circuit 2
k. Short circuit on speaker circuit 3
l. Short circuit on speaker circuit 4
m. Data Transmitted on DAP A
n. Data Received on DAP A
o. Data Transmitted on DAP B
p. Data Received on DAP B
q. Board failure
r. Active fiber optic media connection on port A (fiber optic media applications)
s. Active fiber optic media connection on port B (fiber optic media applications)
t. Power supply Earth Fault
u. Power supply 5V present
v. Power supply conditions - Brownout, High Battery, Low Battery, Charger Trouble

4. The audio amplifier shall provide the following built-in controls:
   a. Amplifier Address Selection Switches
   b. Signal Silence of communication loss annunciation Reset
   c. Level adjustment for background musicd. Enable/Disable for Earth Fault detection on DAP A
   e. Enable/Disable for Earth Fault detection on DAP A
   f. Switch for 2-wire/4-wire FFT riser
5. Adjustment of the correct audio level for the amplifier shall not require any special tools or test equipment.
6. Includes audio input and amplified output supervision, back up input, and automatic switch over function, (if primary amplifier should fail).
7. System shall be capable of backing up digital amplifiers.
8. One-to-one backup shall be provided by either a plug-in amplifier card or a designated backup amplifier of identical model as the primary amplifier.
9. One designated backup amplifier shall be capable of backing up multiple primary amplifiers mounted in the same or adjacent cabinets.
10. Multi-channel operation from a single amplifier shall be supported by the addition of an optional plug-in amplifier card.

L. Audio Message Generator (Prerecorded Voice)/Speaker Control:
1. Each initiating zone or intelligent device shall interface with an emergency voice communication system capable of transmitting a prerecorded voice message to all speakers in the building.
2. Actuation of any alarm initiating device shall cause a prerecorded message to sound over the speakers. The message shall be repeated four (4) times. Pre- and post-message tones shall be supported.
3. A built-in microphone shall be provided to allow paging through speaker circuits.
4. System paging from emergency telephone circuits shall be supported.

5. The audio message generator shall have the following indicators and controls to allow for proper operator understanding and control:
    a. Lamp Test
    b. Trouble
    c. Off-Line Trouble
    d. Microphone Trouble
    e. Phone Trouble
    f. Busy/Wait
    g. Page Inhibited
    h. Pre/Post Announcement Tone

M. Controls with associated LED Indicators:
1. Speaker Switches/Indicators
    a. The speaker circuit control switches/indicators shall include visual indication of active and trouble status for each speaker circuit in the system.
    b. The speaker circuit control panel shall include switches to manually activate or deactivate each speaker circuit in the system.
2. Emergency Two-Way Telephone Control Switches/Indicators
    a. The emergency telephone circuit control panel shall include visual indication of active and trouble status for each telephone circuit in the system.
    b. The telephone circuit control panel shall include switches to manually activate or deactivate each telephone circuit in the system.

N. Remote Transmissions:
1. Provide local energy or polarity reversal or trip circuits as required.
2. The system shall be capable of operating a polarity reversal or local energy or fire alarm transmitter for automatically transmitting fire information to the fire department.
3. Provide capability and equipment for transmission of zone alarm and trouble signals to remote operator's terminals, system printers and annunciators.
4. Transmitters shall be compatible with the systems and equipment they are connected to such as timing, operation and other required features.

O. Field Programming
1. The system shall be programmable, configurable and expandable in the field without the need for special tools, laptop computers, or other electronic interface equipment. There shall be no firmware changes required to field modify the system time, point information, equations, or annunciator programming/information.
2. All field defined programs shall be stored in non-volatile memory.

P. Specific System Operations
1. 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.
2. 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.

Q. System Point Operations:
1. Any addressable device in the system shall have the capability to be enabled or disabled

through the system keypad or video terminal.

2. System output points shall be capable of being turned on or off from the system keypad or the video terminal.
3. Point Read: The system shall be able to display the following point status diagnostic functions without the need for peripheral equipment. Each point shall be annunciated for the parameters listed:
    a. Device Status.
    b. Device Type.
    c. Custom Device Label.
    d. Software Zone Label.
    e. Device Zone Assignments.
    f. Analog Detector Sensitivity.
    g. All Program Parameters.
4. System History Recording and Reporting: The fire alarm control panel shall contain a history buffer that will be capable of storing up to 4000 system events. Each of these events will be stored, with time and date stamp, until an operator requests that the contents be either displayed or printed. The contents of the history buffer may be manually reviewed; one event at a time, and the actual number of activations may also be displayed and or printed. History events shall include all alarms, troubles, operator actions, and programming entries.
5. The history buffer shall use non-volatile memory. Systems which use volatile memory for history storage are not acceptable.
6. Automatic Detector Maintenance Alert: The fire alarm control panel shall automatically interrogate each intelligent system detector and shall analyze the detector responses over a period of time.
7. If any intelligent detector in the system responds with a reading that is below or above normal limits, then the system will enter the trouble mode, and the particular Intelligent Detector will be annunciated on the system display, and printed on the optional system 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.
8. The system shall include the ability (programmable) to indicate a "pre-alarm" condition. This will be used to alert maintenance personal when a detector is at 80% of its alarm threshold in a 60 second period.

2.03 SYSTEM COMPONENTS:

A. Conventional Aspirating Detection
    1. An optional air aspiration detection system shall be available.
    2. The aspirating system shall support multiple sensitivity settings.
    3. The aspirating system shall operate from 24 VDC.
    4. The aspirating system shall provide alarm and trouble relays used to activate a fire alarm control panel.

B. Aspiration System Interface:
    1. The system shall be capable of supporting Interface Modules for integrating Vesda Aspiration detectors into SLC loop of the fire alarm control panel. The Interface Module shall support up to 19 detectors detectors, each SLC loop shall support one interface module.

C. High Level Aspiration System Interface:
    1. The system shall be capable of supporting a High Level Interface for Vesda Aspirating Detection Systems. The interface shall support up to 100 detectors and allow the fire alarm network to monitor and control events on the aspiration system.

D. Portable Emergency Telephone Handset Jack

1. Portable emergency telephone handset jacks shall be flush mounted on stainless steel plates as indicated on plans. Handset jacks shall be approved for emergency telephone system application.
2. Insertion of a remote handset plug into a jack shall send a signal to the fire command center which shall audibly and visually indicate the on-line condition, and shall sound a ring indication in the handset.
3. The two-way emergency telephone system shall support a minimum of seven (7) handsets on line without degradation of the signal.

E. Fixed Emergency Telephone Handset

1. The telephone cabinet shall be painted red and clearly labeled emergency telephone. The cabinets shall be located where shown on drawings.
2. The handset cradle shall have a switch connection such that lifting the handset off of the cradle shall send a signal to the fire command center which shall audibly and visually indicate its on-line (off-hook) condition.
3. The two-way emergency telephone system shall support a maximum of seven (7) handsets on line (off hook) without degradation of the signal.

F. Universal Digital Alarm Communicator Transmitter (UDACT). The UDACT is an interface for communicating digital information between a fire alarm control panel and an UL-Listed central station.

1. 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.
2. 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 two different telephone numbers.
3. The UDACT shall be capable of transmitting events in 4+2, SIA, and Contact ID.
4. Communication shall include vital system status such as:
    a. Independent Zone (Alarm, trouble, non-alarm, supervisory)
    b. Independent Addressable Device Status
    c. AC (Mains) Power Loss
    d. Low Battery and Earth Fault
    e. System Off Normal
    f. 12 and 24 Hour Test Signal
    g. Abnormal Test Signal (per UL requirements)
    h. EIA-485 Communications Failure
    i. Phone Line Failure
5. 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.
6. 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.
7. The UDACT shall be capable of generating Central Station reports providing detailed programming information for each point along with the central station point address.

8. 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.

G. Field Wiring Terminal Blocks

1. For ease of service all panel I/O wiring terminal blocks shall be removable, plug-in types and have sufficient capacity for #18 to #12 AWG wire. Terminal blocks that are permanently fixed are not acceptable.

H. Printer

1. The printer shall provide hard-copy printout of all changes in status of the system and shall time-stamp such printouts with the current time-of-day and date. The printer shall be standard carriage with 80-characters per line and shall use standard pin-feed paper. The printer shall be enclosed in a separate cabinet suitable for placement on a desktop or table. The printer shall communicate with the control panel using an interface complying with Electrical Industries Association standard EIA-232D. Power to the printer shall be 120 VAC @ 60 Hz.

2. The system shall have a strip printer capable of being mounted directly in the main FACP enclosure. Alarms shall be printed in easy-to-read RED, other messages, such as a trouble, shall be printed in BLACK. This printer shall receive power from the system power supply and shall operate via battery back-up if AC mains are lost. The strip printer shall be UL 864 listed.

3. The system shall have a strip printer capable of being mounted directly in the main FACP enclosure. Alarms shall be printed in easy-to-read RED, other messages, such as a trouble, shall be printed in BLACK. This printer shall receive power from the system power supply and shall operate via battery back-up if AC mains are lost. The strip printer shall be UL 864 listed.

I. Smoke Control Annunciator

1. On/Auto/Off switches and status indicators (LEDS) shall be provided for monitoring and manual control of each fan, damper, HVAC control unit, stairwell pressurization fan, and smoke exhaust fan. To ensure compliance the units supplied shall meet the following UL categories: UUKL, PAZX, UDTZ, QVAX as well as the requirements of NFPA 90A, HVAC, and NFPA 92A & 92B, Smoke Control. The control System shall be field programmable for either 90A operation or 92A/B operation to allow for future use and system expansion.

2. The OFF LED shall be Yellow, the ON LED shall be green, the Trouble/Fault LED shall be Amber/Orange for each switch. The Trouble/Fault indicator shall indicate a trouble in the control and/or monitor points associated with that switch. In addition, each group of eight switches shall have two LEDS and one momentary switch which allow the following functions: An Amber LED to indicate an OFF-NORMAL switch position, in the ON or OFF position; A Green LED to indicate ALL AUTO switch position; A Local Acknowledge/Lamp Test momentary switch.

3. Each switch shall have the capability to monitor and control two addressable inputs and two addressable outputs. In all modes, the ON and OFF indicators shall continuously follow the device status not the switch position. Positive feedback shall be employed to verify correct operation of the device being controlled. Systems that indicate on/off/auto by physical switch position only are not acceptable.

4. All HVAC switches (i.e., limit switches, vane switches, etc.) shall be provided and installed by the HVAC contractor.

5. It shall be possible to meet the requirements mentioned above utilizing wall mounted custom graphic.

2.04 GATEWAY & WEBSERVER OPTIONS

A. Common Alerting Protocol (CAP) Gateway: The system shall support an optional CAP Gateway (Common Alerting Protocol). The CAP Gateway translates fire system messages to industry standard CAP messages for integration with CAP-compliant clients. A CAP gateway shall be available from the fire alarm control panel manufacturer.

B. LEDSIGN Gateway: The system shall support an optional and proprietary LEDSIGN Gateway to interface to LED signs that will automatically display emergency messages. The signs shall be capable of storing up to 100 messages that can be activated via system programming with the ability to be manually overridden. The Sign Gateway shall support up to 10 independent signs, each sign capable of playing an independent message. Multiple LEDSIGN Gateways can be used in network applications. An LEDSIGN gateway shall be available from the fire alarm control panel manufacturer.

C. BACnet Interface Gateway: The system shall be capable of being interfaced with BACNet compliant clients. A BACnet interface supporting BACnet/IP communication shall be available from the fire alarm control panel manufacturer.

D. MODbus Interface Gateway: The system shall be capable of being interfaced with MODbus compliant clients. A MODbus interface supporting MODbus/TCP communication shall be available from the fire alarm control panel manufacturer.

E. Noti-Fire-Net Gateway: The system shall support an IP based gateway to enable the panel or local Noti-Fire-Net to be connected to an ONYXWorks workstation via the Internet or Intranet. This gateway shall also support the ability to integrate the system to an interactive firefighter's display. The Noti-Fire-Net Gateway shall be available from the fire alarm control manufacturer.

F. 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.

G. Web Portal Interface: The system shall be capable of being interfaced with a web portal to integrate with Inspection and Service Manager utilities. The web portal and inspection and service manager utilities shall be available from the fire alarm control panel manufacturer.

2.05 SYSTEM COMPONENTS - ADDRESSABLE DEVICES

A. Addressable Devices – General

1. Addressable devices shall provide an address-setting means using rotary decimal switches. Addressable devices that require the address be programmed using a programming utility are not an allowable substitute.

2. 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.

3. 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.

4. 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.

5. Detectors shall be intelligent (analog) and addressable, and shall connect with two wires to the fire alarm control panel Signaling Line Circuits.

6. 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.

7. 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.

8. Using software in the FACP, detectors shall automatically compensate for dust accumula-

tion 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.

9. The detectors shall be ceiling-mount and shall include a separate twist-lock base with tamper proof feature. Base options shall include a sounder base with a built-in (local) sounder rated at 85 DBA minimum, a relay base and an isolator base designed for Style 7 applications. The system shall also support an intelligent programmable sounder base, the programmable sounder base shall be capable of providing multiple tones based on programming and at a minimum be capable of providing a Temp-4 tone for CO (Carbon Monoxide) activation and a Temp-3 tone for fire activations and be capable of being synchronized with other programmable sounder bases and common area notification appliances; 85 DBA minimum.
10. Detectors shall also store an internal identifying type code that the control panel shall use to identify the type of device (ION, PHOTO, THERMAL).
11. 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.
12. Addressable devices shall store an internal identifying code that the control panel shall use to identify the type of device.
13. 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.
14. 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.

B. Addressable Manual Fire Alarm Box (manual station)

1. 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.
2. All operated stations shall have a positive, visual indication of operation and utilize a key type reset.
3. 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.

C. Intelligent Photoelectric Smoke Detector: The intelligent photoelectric smoke detector shall be NOTIFIER model # FSP-851 and shall use the photoelectric (light-scattering) principal to measure smoke density and shall, on command from the control panel, send data to the panel representing the analog level of smoke density.

D. Intelligent VIEW® Laser Photo Smoke Detector: The intelligent laser photo smoke detector shall be a spot type detector, NOTIFIER model # FSL-751, that incorporates an extremely bright laser diode and an integral lens that focuses the light beam to a very small volume near a receiving photo sensor. The scattering of smoke particles shall activate the photo sensor.

1. The laser detector shall have conductive plastic so that dust accumulation is reduced significantly.
2. The intelligent laser photo detector shall have nine sensitivity levels and be sensitive to a minimum obscuration of 0.02 percent per foot.
3. The laser detector shall not require expensive conduit, special fittings or PVC pipe.
4. The intelligent laser photo detector shall support standard, relay, isolator and sounder de-

tector bases.

5. The laser photo detector shall not require other cleaning requirements than those listed in NFPA 72. Replacement, refurbishment or specialized cleaning of the detector head shall not be required.

6. The laser photo detector shall include two bicolor LEDs that flash green in normal operation and turn on steady red in alarm.

E. Intelligent Ionization Smoke Detector: The intelligent ionization smoke detector shall be NOTIFIER model # FSI-851 and shall use the dual-chamber ionization principal to measure products of combustion and shall, on command from the control panel, send data to the panel representing the analog level of products of combustion.

F. 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.

G. 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.

H. Intelligent Duct Smoke Detector: The smoke detector housing shall accommodate an intelligent photoelectric detector that provides continuous analog monitoring and alarm verification from the panel. When sufficient smoke is sensed, an alarm signal is initiated at the FACP, and appropriate action taken to change over air handling systems to help prevent the rapid distribution of toxic smoke and fire gases throughout the areas served by the duct system. The Intelligent Duct Smoke Detector shall support the installation of addressable Photoelectric detector capable or being tested remotely. The Intelligent Duct Detector housing shall be model # DNR(W) and the remote test capable photoelectric smoke detector shall be NOTIFIER model # FSP-851R.

I. IntelliQuad™ Advanced Multi-Criteria Intelligent Detector

1. Intelligent multi-criteria fire detector shall be a NOTIFIER model number FSC-851. Smoke detector shall be an addressable intelligent multi-criteria smoke detector. The detector shall be comprised of four sensing elements, including a photoelectric (light-scattering) particulate sensor, an electrochemical carbon monoxide (CO) sensor, a daylight-filtered infrared sensor and solid state thermal sensor(s) rated at 135°F (57.2°C). The device shall be able to indicate distinct smoke and heat alarms.

2. The intelligent multi-criteria detection device shall include the ability to combine the signal of the photoelectric signal with other sensing elements in an effort to react quickly in the event of a fire situation. It shall also include the inherent ability to distinguish between a fire condition and a nuisance alarm condition. The product design shall be capable of selecting the appropriate sensitivity levels based on the environment type chosen by user in which it

is installed (office, manufacturing, kitchen etc.) and then have the ability to automatically change the setting as the environment changes.

3. The detector shall be capable of automatically adjusting its sensitivity by means of drift compensation and smoothing algorithms. The detector shall be capable of automatically adjusting its sensitivity by means of drift compensation and smoothing algorithms. The device shall provide unique signals to indicate when 20% of the drift range is remaining, when 100% of drift range is used, and when there is a chamber fault to show unit requires maintenance.
4. The detector shall indicate CO trouble conditions including 6 months of sensor life remaining and sensor life has expired. The detector shall indicate a combined signal for any of the following: low chamber trouble, thermistor trouble, CO self test failure, IR self test failure, and freeze warning.
5. The detectors shall provide address-setting means on the detector head using rotary switches. Because of the possibility of installation error, systems that use binary jumpers or DIP switches to set the detector address are not acceptable. The detectors shall also store an internal identifying code that the control panel shall use to identify the type of detector. Systems that require a special programmer to set the detector address (including temporary connection at the panel) are labor intensive and not acceptable. Each detector occupies any one of at least 99 possible addresses on the signaling line circuit (SLC) loop. It responds to regular polls from the system and reports its type and status.
6. The detectors shall provide a test means whereby they will simulate an alarm condition and report that condition to the control panel. Such a test may be initiated at the detector itself (by activating a switch) or initiated remotely on command from the control panel. There are three test methods: functional magnet, smoke entry aerosol, or direct heat method.
7. The detectors shall provide two LEDs to provide 360° visibility. The LEDs are placed into steady red illumination by the control panel indicating that an alarm condition has been detected. An output connection shall also be provided in the base to connect an external remote alarm LED, sounder base, and / or relay base (optional accessories). The external remote alarm can be interconnected to other sounder or relay bases for activating all devices in a space via a single alarming unit.
8. Two LEDs on the sensor are controlled by the panel to indicate sensor status. Coded signals, transmitted from the panel, can cause the LEDs to blink, latch on, or latch off. Refer to the control panel technical documentation for sensor LED status operation and expected delay to alarm.
9. The detectors shall be ceiling-mount and shall be plug-in mounted into a twist-lock base. These detectors shall be constructed of off-white UV resistant polymer and shall be detachable from the mounting base to simplify installation, service and maintenance. Mounting base wiring connections shall be made by means of SEMS screws. The detector shall allow pre-wiring of the base and the head shall be a plug-in type. Mounting base shall be mounted on junction box which is at least 1.5 inches (3.81 cm) deep. Mounting base shall be available to mount to standard junction boxes. Suitable boxes include:
    a. 4.0" (10.16 cm) square box with and without plaster ring.
    b. 4.0" (10.16 cm) octagonal box.
    c. 3.5" (8.89 cm) octagonal box.
    d. Single-gang box.
10. Meets Agency Standards
    a. ANSI/UL 268 -Smoke Detectors for Fire Alarm Signaling Systems
    b. CAN/ULC-S529- Smoke Detectors for Fire Alarm Systems
    c. FM 3230-3250- Smoke Actuated Detectors for Automatic Fire Alarm Signaling

J. IntelliQuad™ PLUS Advanced Multi-Criteria Intelligent Fire/CO Detector

1. Advanced Multi-Criteria Fire/CO detector shall be NOTIFIER model # FCO-851 and shall

be an addressable advanced multi-criteria smoke detector with a separate signal for carbon monoxide (CO) detection per UL 2075 standards.

2. The detector shall be comprised of four sensing elements, including a photoelectric (light-scattering) particulate sensor, an electrochemical CO sensor, a daylight-filtered infrared (IR) sensor and solid state thermal sensor(s) rated at 135°F (57.2°C). The device shall be able to indicate distinct smoke and heat alarms.

3. The advanced multi-criteria detection device shall include the ability to combine the signal of the photoelectric signal with other sensing elements in order to react quickly in the event of a fire situation. It shall also include the inherent ability to distinguish between a fire condition and a nuisance alarm condition. The detector shall be capable of selecting the appropriate sensitivity levels based on the environment type (office, manufacturing, kitchen, etc.) in which it is installed, and then have the ability to automatically change the setting as the environment changes.

4. The CO detector component shall be capable of a functional gas test using a canned test agent to test the functionality of the CO sensing cell.

5. The detector shall be capable of automatically adjusting its sensitivity by means of drift compensation and smoothing algorithms. The device shall provide unique signals to indicate when 20 percent of the drift range is remaining, when 100 percent of drift range is used, and when there is a chamber fault to show the unit requires maintenance.

6. The detector shall indicate CO trouble conditions, including six months of sensor life remaining and sensor life has expired. The detector shall indicate a combined signal for any of the following: low chamber trouble, thermistor trouble, CO self test failure, IR self test failure, and freeze warning.

7. The detector shall provide address-setting means on the detector head using rotary switches. Because of the possibility of installation error, systems that use binary jumpers or DIP switches to set the detector address are not acceptable. The detector shall also store an internal identifying code that the control panel shall use to identify the type of detector. Systems that require a special programmer to set the detector address (including temporary connection at the panel) are labor intensive and not acceptable. Each detector occupies any one of at least 159 possible addresses on the signaling line circuit (SLC) loop. It responds to regular polls from the system and reports its type and status.

8. The detector shall provide a test means whereby it will simulate an alarm condition and report that condition to the control panel. Such a test may be initiated at the detector itself (by activating a switch) or initiated remotely on command from the control panel. There shall be four test methods: functional magnet, smoke entry aerosol, carbon monoxide aerosol or direct heat method.

9. The detector shall provide two LEDs to provide 360° visibility. The LEDs shall be placed into steady red illumination by the control panel indicating that an alarm condition has been detected. An output connection shall also be provided in the base to connect an external remote alarm LED. The detector must be capable of connecting to a sounder base that provides both temporal 3 and temporal 4 patterns for fire and CO alarm.

10. Two LEDs on the sensor shall be controlled by the panel to indicate sensor status. Coded signals, transmitted from the panel, shall cause the LEDs to blink, latch on, or latch off. Refer to the control panel technical documentation for sensor LED status operation and expected delay to alarm.

11. The detector shall be plug-in mounted into a twist-lock base. The detector shall be constructed of off-white, UV-resistant polymer and shall be detachable from the mounting base to simplify installation, service and maintenance. Mounting base wiring connections shall be made by means of SEMS screws. The detector shall allow pre-wiring of the base and the head shall be a plug-in type. The mounting base shall be mounted on a junction box that is at least 1.5 inches (3.81 cm) deep. The mounting base shall be available to mount to standard junction boxes. Suitable boxes include:

    a. 4.0" (10.16 cm) square box with and without plaster ring.

b. 4.0" (10.16 cm) octagonal box.

c. 3.5" (8.89 cm) octagonal box.

d. Single-gang box.

e. Double-gang box

12. Meets Agency Standards

a. ANSI/UL 268 -Smoke Detectors for Fire Alarm Signaling Systems

b. CAN/ULC-S529- Smoke Detectors for Fire Alarm Systems

c. FM 3230-3250- Smoke Actuated Detectors for Automatic Fire Alarm Signaling

d. UL 2075 – Gas and Vapor Detector and Sensors – Systems Connected

K. Intelligent Addressable Aspiration Detector: The intelligent aspiration detector shall be NOTIFIER model # FSA-8000 an addressable aspiration detector that communicates directly with the fire alarm control panel via the SLC communication protocol, no modules or high level interfaces shall be required. The fire alarm control panel shall support up to thirty one intelligent aspiration detectors per SLC loop. The aspiration detector shall have dual source (blue LED and infra-red laser) optical smoke detection for a wide range of fire detection with enhanced immunity to nuisance particulates. The FACP shall be capable of monitoring and annunciating up to five smoke event thresholds and eleven trouble conditions. Each event threshold shall be capable of being assigned a discrete type ID at the FACP.

L. Intelligent Addressable Reflected Beam Detector

1. The intelligent single-ended reflected beam smoke detector shall connect with two wires to the fire alarm control panel signaling line circuit (SLC). The detectors shall consist of a transmitter/receiver unit and a reflector and shall send data to the panel representing the analog level of smoke density. The detector shall be capable of being tested remotely via a keyswitch; NOTIFIER model # FSB-200. Model # FSB-200S shall be equipped with an integral sensitivity test feature.

M. 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.

N. 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.

O. 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.

P. Addressable Releasing Control Module

1. An addressable FlashScan releasing module shall be available to supervise and control compatible releasing agent solenoids; NOTIFIER model # FCM-1-REL.

2. The module shall operate on a redundant protocol for added protection.

3. The module shall be configurable for Style Z or Style Y (Class A/B) and support one 24 volt or two 12 volt solenoids.Add FMM-4-20

Q. Addressable 4-20 mA module shall be available to monitor industry-standard, linear-scale, 4-20 mA protocol sensors. The module converts the sensor output to communication protocol that can be interpreted by the FACP for monitoring and display; NOTIFIER model # FMM-4-20.

1. The module shall support programming of up to five programmable event thresholds.

2. The System shall be FM 6320 (Factory Mutual) approved as a Gas Detection system when employed with the FMM-4-20 monitor module and industry standard 4-20 mA gas detectors.

R. 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.

S. Addressable Two-In / Two-Out Monitor/Relay Module:

1. An addressable Two-In / Two-Out module shall be available; NOTIFIER model # FDRM-1.

2. The two-in/two-out module shall provide two Class B/Style B dry-contact input circuits and two independent Form-C relays rated at up to 3 Amps resistive and up to 2.0 Amps inductive.

T. Isolator Module: Isolator modules shall be provided to automatically isolate wire-to-wire short circuits on an SLC Class A or Class B branch. The isolator module shall limit the number of modules or detectors that may be rendered inoperative by a short circuit fault on the SLC loop segment or branch. At least one isolator module shall be provided for each floor or protected zone of the building; NOTIFIER model # ISO-X.

1. If a wire-to-wire short occurs, the isolator module shall automatically open-circuit (disconnect) the SLC. When the short circuit condition is corrected, the isolator module shall automatically reconnect the isolated section.

2. The isolator module shall not require address-setting, and its operations shall be totally automatic. It shall not be necessary to replace or reset an isolator module after its normal operation.

3. The isolator module shall provide a single LED that shall flash to indicate that the isolator is operational and shall illuminate steadily to indicate that a short circuit condition has been

detected and isolated.

U. Serially Connected Annunciator Requirements

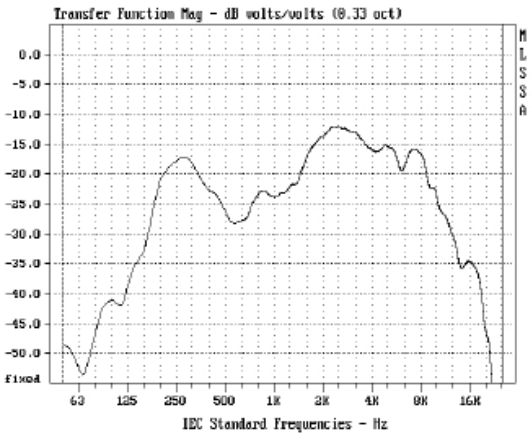
1. The annunciator shall communicate to the fire alarm control panel via an EIA 485 (multi-drop) two-wire communications loop. The system shall support two 6,000 ft. EIA-485 wire runs. Up to 32 annunciators, each configured up to 96 points, may be connected to the connection, for a system capacity of 3,072 points of annunciation.
2. An EIA-485 repeater shall be available to extend the EIA-485 wire distance in 3,000 ft. increments. The repeater shall be UL864 approved.
3. Each annunciator shall provide up to 96 alarm and 97 trouble indications using a long-life programmable color LED's. Up to 96 control switches shall also be available for the control of Fire Alarm Control Panel functions. The annunciator will also have an "ON-LINE" LED, local piezo sounder, local acknowledge and lamp test switch, and custom zone/function identification labels.
4. The annunciator may be field configured to operate as a "Fan Control Annunciator". When configured as "Fan Control," the annunciator may be used to manually control fan or damper operation and can be set to override automatic commands to all fans/dampers programmed to the annunciator.
5. Annunciator switches may be programmed for System control such as, Global Acknowledge, Global Signal Silence, Global System Reset, and on/off control of any control point in the system.
6. An optional module shall be available to utilize annunciator points to drive EIA-485 driven relays. This shall extend the system point capacity by 3,072 remote contacts.
7. The LED annunciator shall offer an interface to a graphic style annunciator and provide each of the features listed above.

V. SpectrAlert Advance Speakers

1. The Speaker appliance shall be System Sensor SpectrAlert Advance model _____ Speaker. 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

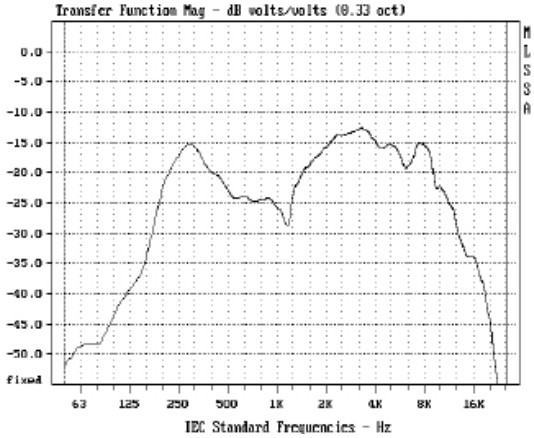
Ceiling Speaker

Wide Band Frequency Response



Wall Speaker

Wide Band Frequency Response



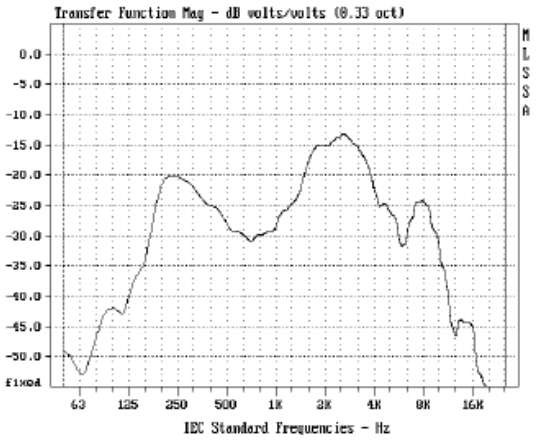
Note: The wide band frequency response is derived using MLS methods

W. SpectrAlert Advance Speaker Strobes

1. The Speaker Strobe appliance shall be System Sensor SpectrAlert Advance model _____ Speaker Strobe. 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.

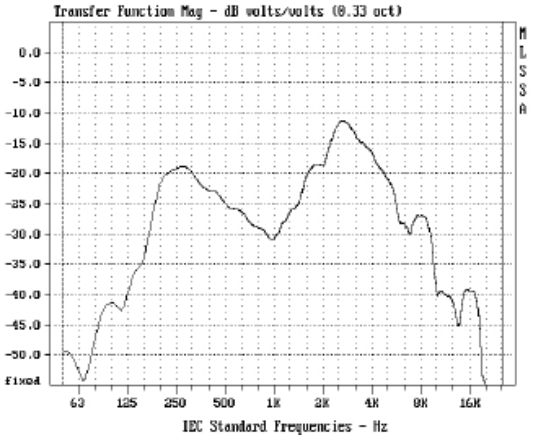
Ceiling Speaker Strobe

Wide Band Frequency Response



Wall Speaker Strobe

Wide Band Frequency Response



Note: The wide band frequency response is derived using MLS methods

6. Strobe lights shall meet the requirements of the ADA, UL Standard 1971and be fully synchronized.

PART 3.0 - EXECUTION

3.01 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.

3.02 TEST:

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.

A. Before energizing the cables and wires, check for correct connections and test for short circuits, ground faults, continuity, and insulation.

B. Close each sprinkler system flow valve and verify proper supervisory alarm at the FACP.

C. Verify activation of all waterflow switches.

D. Open initiating device circuits and verify that the trouble signal actuates.

E. Open and short signaling line circuits and verify that the trouble signal actuates.

F. Open and short notification appliance circuits and verify that trouble signal actuates.

G. Ground all circuits and verify response of trouble signals.

H. Check presence and audibility of tone at all alarm notification devices.

I. Check installation, supervision, and operation of all intelligent smoke detectors using the walk

test.

J. 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.

K. 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.

3.03 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.

3.04 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

SECTION 31 1000

SITE CLEARING

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. Protecting existing vegetation to remain.
2. Removing existing vegetation.
3. Clearing and grubbing.
4. Stripping and stockpiling topsoil.
5. Removing above- and below-grade site improvements.
6. Disconnecting, capping or sealing, and removing site utilities.
7. Temporary erosion- and sedimentation-control measures.

B. Related Sections:

1. Section 01 5000 "Temporary Facilities and Controls" for temporary utility services, construction and support facilities, security and protection facilities.
2. Section 01 7300 "Execution" for field engineering and surveying.
3. Section 01 7419 "Construction Waste Management and Disposal.
4. Geotechnical Study performed by Geomat Inc. and the report: “Geotechnical Engineering Report Navajo Nation Proposed Incident Command Center Shiprock, New Mexico” issued for this project on May 25, 2018. Geomat Inc. can be reached at phone number (505) 327-7928.

1.3 DEFINITIONS

A. Subsoil: All soil beneath the topsoil layer of the soil profile, and typified by the lack of organic matter and soil organisms.

B. Surface Soil: Soil that is present at the top layer of the existing soil profile at the Project site. In undisturbed areas, the surface soil is typically topsoil; but in disturbed areas such as urban environments, the surface soil can be subsoil.

C. Topsoil: Top layer of the soil profile consisting of existing native surface topsoil or existing in-place surface soil and is the zone where plant roots grow.

D. Plant-Protection Zone: Area surrounding individual trees, groups of trees, shrubs, or other vegetation to be protected during construction, and indicated on Drawings.

E. Tree-Protection Zone: Area surrounding individual trees or groups of trees to be protected during construction, and indicated on Drawings.

F. Vegetation: Trees, shrubs, groundcovers, grass, and other plants.

1.4 MATERIAL OWNERSHIP

A. Except for stripped topsoil and other materials indicated to be stockpiled or otherwise remain Owner's property, cleared materials shall become Contractor's property and shall be removed from Project site.

1.5 INFORMATIONAL SUBMITTALS

A. Existing Conditions: Documentation of existing trees and plantings, adjoining construction, and site improvements that establishes preconstruction conditions that might be misconstrued as damage caused by site clearing.

1. Use sufficiently detailed photographs or videotape.
2. Include plans and notations to indicate specific wounds and damage conditions of each tree or other plants designated to remain.

B. Record Drawings: Identifying and accurately showing locations of capped utilities and other subsurface structural, electrical, and mechanical conditions.

1.6 QUALITY ASSURANCE

A. Preinstallation Conference: Conduct conference as needed.

1.7 PROJECT CONDITIONS

A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during site-clearing operations.

1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
2. Provide alternate routes around closed or obstructed traffic ways if required by Owner or authorities having jurisdiction.

B. Improvements on Adjoining Property: Authority for performing site clearing indicated on property adjoining Owner's property will be obtained by Owner before award of Contract.

1. Do not proceed with work on adjoining property until directed by Architect.

C. Salvable Improvements: Carefully remove items indicated to be salvaged and store on Owner's premises where indicated.

D. Utility Locator Service: Notify utility locator service for area where Project is located before site clearing.

E. Do not commence site clearing operations until temporary erosion- and sedimentation-control and plant-protection measures are in place.

F. The following practices are prohibited within protection zones:

1. Storage of construction materials, debris, or excavated material.
2. Parking vehicles or equipment.
3. Foot traffic.
4. Erection of sheds or structures.
5. Impoundment of water.
6. Excavation or other digging unless otherwise indicated.
7. Attachment of signs to or wrapping materials around trees or plants unless otherwise indicated.

G. Do not direct vehicle or equipment exhaust towards protection zones.

H. Prohibit heat sources, flames, ignition sources, and smoking within or near protection zones.

I. Soil Stripping, Handling, and Stockpiling: Perform only when the topsoil is dry or slightly moist.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Satisfactory Soil Material: Requirements for satisfactory soil material are specified in Section 31 2000 "Earth Moving."

1. Obtain approved borrow soil material off-site when satisfactory soil material is not available on-site.

PART 3 - EXECUTION

3.1 PREPARATION

A. Protect and maintain benchmarks and survey control points from disturbance during construction.

B. Locate and clearly identify trees, shrubs, and other vegetation to remain or to be relocated. Flag each tree trunk at 54 inches above the ground.

C. Protect existing site improvements to remain from damage during construction.

1. Restore damaged improvements to their original condition, as acceptable to Owner.

3.2 TEMPORARY EROSION AND SEDIMENTATION CONTROL

A. Provide temporary erosion- and sedimentation-control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according to erosion- and sedimentation-control Drawings and requirements of authorities having jurisdiction.

B. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross protection zones.

C. Inspect, maintain, and repair erosion- and sedimentation-control measures during construction until permanent vegetation has been established.

D. Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.

3.3 TREE AND PLANT PROTECTION

A. General: Protect trees and plants remaining on-site.

B. Repair or replace trees, shrubs, and other vegetation indicated to remain or be relocated that are damaged by construction operations, in a manner approved by Architect.

3.4 EXISTING UTILITIES

A. Locate, identify, disconnect, and seal or cap utilities indicated to be removed or abandoned in place.

1. Arrange with utility companies to shut off indicated utilities.

B. Locate, identify, and disconnect utilities indicated to be abandoned in place.

C. Interrupting Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:

1. Notify Architect not less than two days in advance of proposed utility interruptions.

2. Do not proceed with utility interruptions without Architect's written permission.

D. Excavate for and remove underground utilities indicated to be removed.

3.5 CLEARING AND GRUBBING

A. Remove obstructions, trees, shrubs, and other vegetation to permit installation of new construction.

1. Do not remove trees, shrubs, and other vegetation indicated to remain or to be relocated.

2. Grind down stumps and remove roots, obstructions, and debris to a depth of 18 inches below exposed subgrade.

3. Use only hand methods for grubbing within protection zones.

4. Chip removed tree branches and dispose of off-site.

B. Fill depressions caused by clearing and grubbing operations with satisfactory soil material unless further excavation or earthwork is indicated.

1. Place fill material in horizontal layers not exceeding a loose depth of 6 inches, and compact each layer to a density equal to adjacent original ground.

3.6 TOPSOIL STRIPPING

A. Remove sod and grass before stripping topsoil.

B. Strip topsoil to depth indicated on Drawings in a manner to prevent intermingling with underlying subsoil or other waste materials.

1. Remove subsoil and nonsoil materials from topsoil, including clay lumps, gravel, and other objects more than 2 inches in diameter; trash, debris, weeds, roots, and other waste materials.

C. Stockpile topsoil away from edge of excavations without intermixing with subsoil. Grade and shape stockpiles to drain surface water. Cover to prevent windblown dust and erosion by water.

1. Limit height of topsoil stockpiles to 72 inches.

2. Do not stockpile topsoil within protection zones.

3. Dispose of surplus topsoil. Surplus topsoil is that which exceeds quantity indicated to be stockpiled or reused.

3.7 SITE IMPROVEMENTS

A. Remove existing above- and below-grade improvements as indicated and necessary to facilitate new construction.

B. Remove slabs, paving, curbs, gutters, and aggregate base as indicated.

1. Unless existing full-depth joints coincide with line of demolition, neatly saw-cut along line of existing pavement to remain before removing adjacent existing pavement. Saw-cut faces vertically.

2. Paint cut ends of steel reinforcement in concrete to remain with two coats of antirust coating, following coating manufacturer's written instructions. Keep paint off surfaces that will remain exposed.

3.8 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Remove surplus soil material, unsuitable topsoil, obstructions, demolished materials, and waste materials including trash and debris, and legally dispose of them off Owner's property.

END OF SECTION

SECTION 31 2000

EARTH MOVING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Excavating and filling for grading the Site.
2. Preparing subgrades for slabs-on-grade, walks, and pavements.
3. Base course for concrete walks and concrete and asphalt paving.
4. Excavating and backfilling trenches for utilities

B. Related Documents

1. Geotechnical Study performed by Geomat Inc. and the report: “Geotechnical Engineering Report Navajo Nation Proposed Incident Command Center Shiprock, New Mexico” issued for this project on May 25, 2018. Geomat Inc. can be reached at phone number (505) 327-7928.

1.2 DESCRIPTION OF WORK:

A. Fill construction shall consist of the placing and compacting of approved material within areas where unsuitable material has been removed; the placing and compacting of material in holes, pits and other depressions.

B. Preparation of sub grade for walks and pavements is included as part of this work.

C. Backfilling of trenches included as part of this work.

D. Definition – “Excavation” consists of removal of material encountered to sub grade elevations indicated and subsequent disposal of materials removed.

1.3 DEFINITIONS:

A. Backfill: Soil material used to fill an excavation.

1. Initial Backfill: Backfill placed beside and over pipe in a trench, including haunches to support sides of pipe.
2. Final Backfill: Backfill placed over initial backfill to fill a trench.

B. Base Course: Aggregate layer placed between the subgrade and hot-mix asphalt paving and concrete walks and paving.

C. Bedding Course: Aggregate layer placed over the excavated subgrade in a trench before laying pipe.

D. Borrow Soil: Satisfactory soil imported from off-site for use as fill or backfill.

E. Drainage Course: Aggregate layer supporting the slab-on-grade that also minimizes upward capillary flow of pore water.

F. Excavation: Removal of material encountered above subgrade elevations and to lines and dimensions indicated.

1. Authorized Additional Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions as directed by Architect. Authorized additional excavation and replacement material will be paid for according to Contract provisions for changes in the Work.
2. Unauthorized Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions without direction by Architect. Unauthorized excavation, as well as remedial work directed by Architect, shall be without additional compensation.

G. Fill: Soil materials used to raise existing grades.

H. Structures: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below the ground surface.

I. Subgrade: Uppermost surface of an excavation or the top surface of a fill or backfill immediately below base course, drainage fill, drainage course, or topsoil materials.

J. Utilities: On-site underground pipes, conduits, ducts, and cables as well as underground services within buildings.

1.4 PREINSTALLATION MEETINGS

A. Pre-installation Conference: Conduct pre-excavation conference at Project site.

1.5 SUBMITTALS

A. Product Data: For each type of the following manufactured products required:

1. Geotextiles.
2. Warning tapes.

B. Samples for Verification: For the following products, in sizes indicated below:

1. Geotextile: 12 by 12 inches.
2. Warning Tape: 12 inches long; of each color.

C. Testing Reports: Submit following reports directly to the Architect/Engineers from a qualified testing agency, with copy to Contractor.

1. Test reports for onsite and borrow material for fill and backfill.
2. Inspection of sub grade to check actual soil conditions.
3. Field density test reports.
4. One optimum moisture-maximum density curve for each type of soil encountered.
5. Report of testing performed to determine suitability of materials used.

1.6 QUALITY ASSURANCE

A. Codes and Standards: Perform excavation work in compliance with applicable requirements of governing authorities having jurisdiction.

B. Testing and Inspection Service: Employ, at Contractor’s expense, testing laboratory to perform soil testing and inspection service for quality control testing during earthwork operations.

1.7 PROJECT CONDITIONS

A. Site Information: Data on indicated subsurface conditions are not intended a representations or warranties of accuracy or continuity between soil bearings. It is expressly understood that Owner will not be responsible for interpretations or conclusions drawn there from by Contractor. Data are made available for convenience of Contractor.

B. Additional test borings and other exploratory operations may be made by Contractor at no cost to Owner.

C. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during earth moving operations.

1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
2. Provide alternate routes around closed or obstructed traffic ways if required by Owner or authorities having jurisdiction.

D. Existing Utilities: Locate existing underground utilities in areas of work. If utilities are to remain in place, provide adequate means of support and protection during earthwork operations.

E. Utility Locator Service: Notify utility locator service for area where Project is located before beginning earth moving operations.

F. Should uncharted, or incorrectly charted, piping or other utilities be encountered during excavation, consult utility owner immediately for directions. Cooperated with Architect/Engineer and utility companies in keeping respective services and facilities in operation. Repair damaged utilities to satisfaction of utility owner.

G. Do not interrupt existing utilities serving facilities occupied and used by Owner or others, during occupied hours, except when permitted in writing by the Architect/Engineer and then only after acceptable temporary utility services have been provided.

H. Provide a minimum of 48-hour notice to the Architect/Engineer, and received written notice to proceed before interrupting any utility.

I. Use of Explosives: The use of explosives is not permitted.

J. Protection of Persons and Property: Barricade open excavations occurring as part of this work and post with warning lights.

K. Operate warning lights as recommended by authorities having jurisdiction.

L. Protect structures, utilities, sidewalks, pavements and other facilities from damage cause by settlement, lateral movement, undermining, washout and other hazards created by earthwork operations.

M. Do not commence earth moving operations until temporary erosion- and sedimentation-control measures, specified in Division 01 Section "Temporary Facilities and Controls," are in place.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

A. General: Provide material in accordance with the project geotechnical report. Use the requirements below for items not specifically addressed in the project geotechnical report. Imported materials may be required to meet the criteria given in the geotechnical report and noted below.

B. Satisfactory Soils: Soil Classification Groups GW, GP, GM, SW, SP, and SM according to ASTM D 2487, or a combination of these groups; free of rock or gravel larger than 3 inches in any dimension, debris, waste, frozen materials, vegetation, and other deleterious matter.

C. Unsatisfactory Soils: Soil Classification Groups GC, SC, CL, ML, OL, CH, MH, OH, and PT according to ASTM D 2487, or a combination of these groups.

1. Unsatisfactory soils also include satisfactory soils not maintained within 2 percent of optimum moisture content at time of compaction.

D. Base Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand.

1. Coarse Aggregate Type: Conforming to New Mexico State Department of Transportation standard specification requirements of Section 303 for Type I Base Course.

E. Engineered Fill: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; with at least 90 percent passing a 1-1/2-inch sieve and not more than 12 percent passing a No. 200 sieve.

F. Bedding Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; except with 100 percent passing a 1-inch sieve and not more than 8 percent passing a No. 200 sieve.

2.2 GEOTEXTILES

A. Subsurface Drainage Geotextile: Nonwoven needle-punched geotextile, manufactured for subsurface drainage applications, made from 100% polypropylene staple filaments; with elongation at break greater than 50 percent; complying with AASHTO M 288 and the following, measured per test methods referenced:

1. Survivability: Class 2; AASHTO M 288.
2. Tensile Strength: 160 lbf; ASTM D 4632.

3. Trapezoidal Tear: 60 lbf; ASTM D 4533.
4. CBR Puncture: 410 lbf; ASTM D 6241.
5. Apparent Opening Size: No. 70 sieve, maximum; ASTM D 4751.
6. Permittivity: 1.5 second^{-1}, minimum; ASTM D 4491.
7. Water Flow Rate: 110 g/min/sf; ASTM D 4491.
8. UV Resistance: 70 percent after 500 hours' exposure; ASTM D 4355.

B. In the placement of the geotextile for drainage applications, the geotextile shall be placed loosely with no wrinkles or folds, and with no void spaces between the geotextile and the ground surface. Successive sheets of geotextiles shall be overlapped a minimum of 12 in., with the upstream sheet overlapping the downstream sheet.

C. Should the geotextile be damaged during installation or riprap placement, a geotextile patch shall be placed over the damaged area extending beyond the damaged area a distance of 12 in., or the specified seam overlap, whichever is greater.

2.3 ACCESSORIES

A. Warning Tape: Acid- and alkali-resistant, polyethylene film warning tape manufactured for marking and identifying underground utilities, 6 inches wide and 4 mils thick, continuously inscribed with a description of the utility; colored to comply with local practice or requirements of authorities having jurisdiction.

B. Detectable Warning Tape: Acid- and alkali-resistant, polyethylene film warning tape manufactured for marking and identifying underground utilities, a minimum of 6 inches wide and 4 mils thick, continuously inscribed with a description of the utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches deep; colored to comply with local practice or requirements of authorities having jurisdiction.

PART 3 - EXECUTION

3.1 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earth-moving operations.

B. Protect and maintain erosion and sedimentation controls during earth-moving operations.

C. Protect subgrades and foundation soils from freezing temperatures and frost. Remove temporary protection before placing subsequent materials.

3.2 EXCAVATION, GENERAL

A. Unclassified Excavation: Excavate to subgrade elevations regardless of the character of surface and subsurface conditions encountered. Unclassified excavated materials may include rock, soil materials, and obstructions. No changes in the Contract Sum or the Contract Time will be authorized for rock excavation or removal of obstructions.

1. If excavated materials intended for fill and backfill include unsatisfactory soil materials and rock, replace with satisfactory soil materials.

3.3 EXCAVATION FOR STRUCTURES

A. Excavation is Unclassified, and includes excavation to subgrade elevations indicated, regardless of character of materials and obstructions encountered.

B. Unauthorized excavation consists of removal of materials beyond indicated subgrade elevations or dimensions without specific direction of the Architect/Engineer. Unauthorized excavation, as well as remedial work directed by the Architect/Engineer, shall be at Contractor’s expense.

C. Under retaining walls, fill unauthorized excavation by extending indicated bottom elevation of footing or base to excavation bottom, without altering required top elevation. Lean concrete fill may be used to bring elevations to proper position, when acceptable to the Architect/Engineer.

D. Elsewhere, backfill and compact unauthorized excavations as specified for authorized excavations of same classification, unless otherwise directed by the Architect/Engineer.

E. Additional Excavation: When excavation has reached required sub grade elevations, notify Architect/Engineer who will make an inspection of conditions.

1. If unsuitable bearing materials are encountered at required subgrade elevations, carry excavations deeper and replace excavated material as directed by Architect/Engineer and/or as outlined in the geotechnical engineering reports.

F. Stability of Excavations: Slope sides of excavations to comply with local codes and ordinances having jurisdiction. Shore and brace where sloping is not possible because of space restrictions or stability of material excavated.

1. Maintain sides and slopes of excavations in safe conditions until completion of backfilling.

G. Cold Weather Protection: Protect excavation bottoms against freezing when atmospheric temperature is less than 35°F.

3.4 EXCAVATION FOR WALKS AND PAVEMENTS

A. Excavate surfaces under walks and pavements to indicated lines, cross sections, elevations, and subgrades.

3.5 EXCAVATION FOR UTILITY TRENCHES

A. Trenching for site utilities coordinate with Navajo Tribal Utility Authority's Technical Specifications for Materials and Workmanship for Water and Wastewater Facilities.

B. Excavation for Trenches: Dig trench to the uniform width required for particular item to be installed, sufficiently wide to provide ample working room. Excavate trenches to depth indicated or required. Carry depth of trenches for piping to establish indicated flow lines and invert elevations. Beyond building perimeter, keep bottoms of trenches sufficiently below finish grade to avoid freeze-ups.

1. For pipes or conduit 5" or less in nominal size and for flat-bottomed multiple-duct conduit units, do not excavate beyond indicated depths. Hand excavate bottom cut to accurate elevations and support pipe or conduit on undisturbed soil.

2. For pipes or conduit 6" or larger in nominal size, tanks and other mechanical/electrical work indicated to receive sub-base, excavate to sub-base depth indicated, or, if not otherwise indicated, to 6" below bottom or work to be supported. Except as otherwise indicated, excavate for exterior water-bearing piping (water, steam, condensate, drainage) so top of piping is not less than 3'-6" below finished grade.

3. Grade bottoms of trenches as indicated, notching under pipe bells to provide soild bearing for entire body of pipe.

4. Do not backfill trenches until tests and inspections have been made and backfilling authorized by the Architect/Engineer. Use care in backfilling to avoid damage or displacement or pipe systems.

C. Dewatering: Prevent surface water and subsurface or ground water from flowing into excavations and from flooding project site and surrounding area.

1. Do not allow water to accumulate in excavations. Remove water to prevent soil changes detrimental to stability of subgrades. Provide and maintain pumps, well points, sumps, suction and discharge lines, and other dewatering system components necessary to convey water away from excavations. Establish and maintain temporary drainage ditches and other diversions outside excavation limits to convey rain water and water removed from excavations to collecting or run-off areas. Do not use trench excavations as temporary drainage ditches.

3.6 SUBGRADE INSPECTION

A. Proof-roll subgrade below the pavements with a pneumatic-tired dump truck to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.

B. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by Architect, without additional compensation.

3.7 UNAUTHORIZED EXCAVATION

A. Fill unauthorized excavation under foundations or wall footings by extending bottom elevation of concrete foundation or footing to excavation bottom, without altering top elevation. Lean concrete fill, with 28-day compressive strength of 3000 psi, may be used when approved by Architect.

1. Fill unauthorized excavations under other construction, pipe, or conduit as directed by Architect.

3.8 STORAGE OF SOIL MATERIALS

A. Stockpile borrow soil materials and excavated satisfactory soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.

1. Located and retain soil materials away from edge of excavations. Do not store within drop line of trees indicated to remain.
2. Dispose of excess soil material and waste materials as herein specified.

3.9 UTILITY TRENCH BACKFILL

A. Utility trenching and backfilling shall be in accordance with N.T.U.A. Technical Specifications for Materials and Workmanship for Water and Wastewater Facilities, Technical Provision (TP) 1.0.

3.10 SOIL FILL

A. Plow, scarify, bench, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so fill material will bond with existing material.

B. Place and compact fill material in layers to required elevations as follows:

1. Under grass and planted areas, use satisfactory soil material.
2. Under walks and pavements, use satisfactory soil material.
3. Under steps and ramps, use engineered fill.

3.11 SOIL MOISTURE CONTROL

A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill soil layer before compaction to within 2 percent of optimum moisture content.

1. Do not place backfill or fill soil material on surfaces that are muddy, frozen, or contain frost or ice.
2. Remove and replace, or scarify and air dry, otherwise satisfactory soil material that exceeds optimum moisture content by 2 percent and is too wet to compact to specified dry unit weight.

3.12 COMPACTION, GENERAL

A. General: Control soil compaction during construction providing minimum percentage of density specified for each area classification as outlined in the geotechnical engineering reports.

1. Remove and replace, or scarify and air dry, soil material that is too wet to permit compaction to specified density.
2. Soil material that has been removed because it is too web to permit compaction may be stockpiled or spread and allowed to dry. Assist drying by discing, harrowing or pulverizing until moisture content is reduced to a satisfactory value.

3.13 COMPACTION OF SOIL BACKFILLS AND FILLS

A. General: Place acceptable soil material in layers to required subgrade elevations, for each areas classification listed below, as outlined in the geotechnical engineering reports.

B. In excavation, use satisfactory excavated or borrow material.

C. Under grassed areas, use satisfactory excavated or borrow material.

D. Under walks and pavements, use sub-base material, or satisfactory excavated or borrow material, or combination of both.

E. Under steps, use sub-base material.

F. Under piping and conduit, use sub-base material where sub-base is indicated under piping or conduit; shape to fit bottom 90° of cylinder.

G. Backfill excavations as promptly as work permits, but not until completion of the following:

1. Acceptance of construction below finish grade including, where applicable, damp-proofing, waterproofing and perimeter insulation.
2. Inspection, testing, approval and recording locations of underground utilities.
3. Removal of concrete formwork.
4. Removal of trash and debris.
5. Permanent or temporary horizontal bracing is in place on horizontally supported walls.

H. Ground Surface Preparation: Remove vegetation, debris, unsatisfactory soil material, obstructions and deleterious materials from ground surface prior to placement of fills. Plow, strip or bread-up sloped surfaces steeper than 1 vertical to 4 horizontal so that fill material will bond with existing surface.

1. When existing ground surface has a density less than that specifies under “Compaction” for particular area classification, break up ground surface, pulverize, moisture-condition to optimum moisture content and compact to required depth and percentage of maximum density.

I. Placement and Compaction: Place backfill and fill materials in layers not more than 8” in loose depth for material compacted by heavy compaction equipment, and not more than 4” in loose depth for material compacted by hand-operated tampers. Coordinate with requirements as outlined in the geotechnical engineering report.

1. Before compaction, moisten or aerate each layer as necessary to provide optimum moisture content. Compact each layer to required percentage of maximum dry density or relative dry density for each areas classification. Do not place backfill or fill material on surfaces that are muddy, frozen or contain frost or ice.
2. Place backfill and fill materials evenly adjacent to structures, piping or conduit to required elevations. Take care to prevent wedging action of backfill against structures or displacement of piping or conduit by carrying material uniformly around structure, piping or conduit to approximately same elevation in each lift.

3.14 GRADING

A. General: Uniformly grade areas within limits of grading under this section, including adjacent transition areas. Smooth finished surface within specified tolerances, compact with uniform levels or slopes between points where elevations are indicated, or between such points and existing grades.

B. Grading Outside Building Lines: Grade areas adjacent to building lines to drain away from structures and to prevent ponding.

C. Finish surfaces free from irregular surface changes, and as follows:

D. Lawn or Unpaved Areas: Finish area to receive topsoil to within now more than 0.10’ above or below required subgrade elevations.

E. Walks and Pavements: Shape surface or areas under pavement to line, grade and cross-section, with finish surface not more than 0.10’ above or below required subgrade elevation.

F. Compaction: After grading, compact subgrade surfaces to the depth and indicated percentage of maximum or relative density for each areas classification as outlined in the geotechnical engineering reports.

3.15 BASE COURSES UNDER PAVEMENTS AND WALKS

A. Place base course on subgrades free of mud, frost, snow, or ice.

B. On prepared subgrade, place base course under pavements and walks as follows:

1. Shape base course to required crown elevations and cross-slope grades.

2. Place base course that exceeds 6 inches in compacted thickness in layers of equal thickness, with no compacted layer more than 6 inches thick or less than 3 inches thick.

3. Compact base course at optimum moisture content to required grades, lines, cross sections, and thickness to not less than 95 percent of maximum dry unit weight according to ASTM D 1557.

3.16 FIELD QUALITY CONTROL

A. Special Inspections: Contractor will engage a qualified special inspector to perform the following special inspections:

1. Determine prior to placement of fill that site has been prepared in compliance with requirements.

2. Determine that fill material and maximum lift thickness comply with requirements.

3. Determine, at the required frequency, that in-place density of compacted fill complies with requirements.

B. Testing Agency: Contractor will engage a qualified geotechnical engineering testing agency to perform tests and inspections.

C. Allow testing agency to inspect and test subgrades and each fill or backfill layer. Proceed with subsequent earth moving only after test results for previously completed work comply with requirements.

D. When testing agency reports that subgrades, fills, or backfills have not achieved degree of compaction specified, scarify and moisten or aerate, or remove and replace soil materials to depth required; recompact and retest until specified compaction is obtained.

E. Testing agency will test compaction of soils in place according to ASTM D 1556, ASTM D 2167, ASTM D 2937, and ASTM D 6938, as applicable. Tests will be performed at the following locations and frequencies:

1. Paved Areas: At subgrade and at each compacted fill and backfill layer, at least one test for every 2000 sq. ft. or less of paved area or building slab but in no case fewer than three tests.

F. If, in the opinion of the Architect/Engineer, based on testing service reports and inspection, subgrade or fills which have been placed are below specified density, provide additional compaction and testing at no additional expense.

3.17 PROTECTION

A. Protecting Graded Areas: Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris.

B. Repair and reestablish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather conditions.

C. Where settling occurs before Project correction period elapses, remove finished surfacing, backfill with additional soil material, compact, and reconstruct surfacing.

1. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to greatest extent possible.

3.18 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Remove surplus satisfactory soil and waste materials, including unsatisfactory soil, trash, and debris, and legally dispose of them off Owner's property.

END OF SECTION

SECTION 31 2311

EARTHWORK FOR BUILDING CONSTRUCTION

PART 1 GENERAL

1.01 WORK INCLUDED

A. The work covered by this Section consists of furnishing all plant, labor, equipment, appurtenances and material in performing all operations, hauling, placing, spreading, watering, processing, compacting and shaping earth sections, within the building limits, complete in place in accordance with the Project Manual and Drawings.

1.02 RELATED WORK ELSEWHERE

A. Clearing - Section 31 10 00

B. Under-Slab Vapor Retarder – Section 07 26 00

C. General Foundation Notes on Drawings.

D. Project Soils Report – shall be completely reviewed and understood by the contractor. In case of conflict or omission, the Project Soils Report shall govern.

1.03 SUBSURFACE SOIL DATA

A. Subsurface soil investigations have been made and the results are available for examination by the Contractor. This is not a warranty of conditions, the Contractor is expected to examine the site and determine for himself the character of materials to be encountered.

B. No additional allowance will be made for rock removal, site clearing and grading, filling, compaction, disposal, or removal of any unclassified materials.

1.04 REFERENCES

A. ASTM International

1.	ASTM D 1556-07	Standard Test Method for Density of Soil in Place by the Sand-Cone Method
2.	ASTM D 1557-09	Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft^3 (2,700 kN-m/m^3))
3.	ASTM D 4318-10	Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils
4.	ASTM D 6938-10	Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)

1.05 SUBMITTALS

A. Submit copies of materials certificates and test results for materials in accordance with type of tests, frequencies and remarks as outlined in the sampling and testing schedule.

1.06 TESTING AND INSPECTION

A. General: The Owner shall employ the services of a registered, licensed Geotechnical Engineer to observe all controlled earthwork soil testing. The testing laboratory shall provide continuous on-site observation by experienced personnel during construction of fill material. The Contractor shall notify the testing laboratory at least two working days in advance of any field operations of controlled earthwork, or of any resumption of operations after stoppages.

B. Report of Field Density Tests

1. The Geotechnical Engineer shall submit, daily, the results of field density tests required by these specifications.

C. Costs of Tests and Inspection

1. The cost of testing, inspecting and engineering, as specified in this section of the specifications, shall be borne by the Owner.

D. Lines and Grades: Alignment and grade of all elements shall be made on true tangents and curves. Grades shall conform to the elevations indicated on Drawings, with minor adjustments,

to provide a smooth approach at building lines, at connections to existing paving and to provide proper drainage. Correct irregularities at no cost to the Owner.

1.07 WEATHER LIMITATIONS

A. Controlled fill shall not be constructed when the atmospheric temperature is below 35 degrees F. When the temperature falls below 35 degrees, it shall be the responsibility of the Contractor to protect all areas of completed work against any detrimental effects of ground freezing by methods approved by the testing laboratory. Any areas that are damaged by freezing shall be reconditioned, reshaped, and compacted by the Contractor in conformance with the requirements of this specification without additional cost to the Owner.

PART 2 PRODUCTS

2.01 STRUCTURAL FILL MATERIAL

A. Material shall consist of soils that conform to the following physical characteristics:

Sieve Size	Percent Passing
Sq. Openings	By Weight
3 inch	100
No. 4	50 - 100
No. 200	50 Max

a. Maximum Expansive Potential (%) * = 1.5

i. * Measured on a sample compacted to approximately 95 percent of the ASTM D698 maximum dry density at about 3 percent below optimum water content. The sample is confined under a 144 psf surcharge and submerged.

b. Aggregate base should conform to Type I Base Course as specified in Section 303 of the 2014 New Mexico Department of Transportation (NMDOT) “Standard Specifications for Road and Bridge Construction”

B.

PART 3 EXECUTION

3.01 PREPARATION

A. Clearing and Grubbing: Prior to placing structural fill all borrow areas and areas to receive structural fill shall be stripped of vegetation and deleterious materials. Strippings shall be hauled offsite or stockpiled for subsequent use in landscaped areas or non-structural fill areas as designated by the Owner or his representative and approved by the Geotechnical Engineer.

3.02 CONSTRUCTION AREA TREATMENT

A. Site Preparation - Fill Areas: Prior to placing structural fill the areas to be filled shall be scarified to a depth of eight inches and moisture conditioned as described below. The area to be filled shall then be compacted to a minimum of 95 percent of maximum density as determined in accordance with ASTM D 698. Any soft or "spongy" areas shall be removed as directed by the Geotechnical Engineer and replaced with structural fill as described herein.

B. Site Preparation - Cut Areas: Following excavation to rough grade all building and pavement areas shall be scarified to a depth of eight inches and moisture conditioned as described below. All building and paved areas shall be compacted to a minimum of 95 percent of maximum density as determined by ASTM D 698.

3.03 EQUIPMENT AND METHODS

A. In areas not accessible to heavy equipment, distribute by and compact with hand operated vibratory compactors.

3.04 BORROW

A. The Contractor shall provide sufficient material for fill to the lines, elevations and cross sections as shown on the contract drawings from borrow areas.

B. The Contractor shall obtain from the Owners of said borrow areas the right to excavate material, shall pay all royalties and other charges involved, and shall pay all expenses in developing the source including the cost of right-of-way required for hauling the material.

3.05 COMPACTION

A. Fill shall be spread in layers not exceeding 10 inches, watered as necessary, and compacted. Moisture content at time of compaction shall plus/minus 2 percent of optimum moisture. A density of not less than 95 percent of maximum dry density shall be obtained within the building pads.

B. Optimum moisture content and maximum dry density for each soil type used shall be determined in accordance with ASTM D 698.

C. Compaction of the fill shall be by mechanical means only. Where vibratory compaction equipment is used, it shall be the Contractor's responsibility to ensure that the vibrations do not damage nearby buildings or other adjacent property. Where vibratory compaction is not possible, pneumatic rolling equipment shall be used.

MATERIAL	MINIMUM PERCENT COMPACTION
Structural & granular fill in construction area	95
Subgrade below structural fill	95
Structural fill under exterior walls	95
Miscellaneous backfill	90

3.06 MOISTURE CONTROL

A. The material, while being compacted, shall be within the moisture range of 2 percent below to 2 percent above optimum, well distributed throughout the layer.

3.07 DENSITY REQUIREMENTS

A. Density of undisturbed soils, in-place fill and backfill shall be determined in accordance with the procedures of ASTM D 1556 or ASTM D 6938. If tests indicate that the density of in-place soil is less than required, the material shall be scarified, moistened or dried as necessary to obtain proper moisture content and recompacted as necessary to achieve the proper densities. Sufficient density tests shall be made and reports submitted by the Testing Laboratory indicating all cut and fill areas were compacted and graded in accordance with the requirements.

3.08 SLOPE PROTECTION & DRAINAGE

A. Berming and grading shall be done as may be necessary to prevent surface water from flowing into and out of the construction area. Any water accumulating therein shall be removed by pumping or by other methods.

3.09 SOIL EROSION PROTECTION

A. The Contractor shall ensure that no soil erodes or blows from the site into public right-of-way or onto private property.

B. The Contractor shall promptly clean up any material which erodes or blows into the public right-of-way or onto private property.

3.10 PRESERVATION OF PROPERTY

A. Provide temporary fences, barricades, coverings, or other protections to preserve existing items indicated to remain and to prevent injury or damage to persons or property. Apply protections to adjacent properties as required.

B. Restore damaged work to condition existing prior to start of work, unless otherwise directed.

3.11 EXISTING UTILITIES

A. The Contractor shall verify the location of any utility lines, pipelines, or underground utility lines in or near the area of the work in advance of and during Earthwork. The Contractor is fully responsible for any and all damage caused by failure to locate, identify and preserve any and all

existing utilities, pipelines and underground utility lines. Repair damaged utilities to the satisfaction of the utility owner at no expense to the Owner.

B. Should uncharted or incorrectly charted piping or other utilities be encountered during grading, consult the Architect immediately for directions as to procedures.

C. Cooperate with the Owner and public or private utility companies in keeping service and facilities in operation.

3.12 WASTE

A. Dispose of all waste off Owner's property.

B. Burning of waste will not be permitted.

3.13 AIR POLLUTION

A. Use water sprinkling, temporary enclosures, and other suitable methods to limit dust and dirt air pollution. Comply with governing regulations pertaining to environmental protection.

B.

SAMPLING AND TESTING SCHEDULE
FOR EARTHWORK

FIELD QUALITY CONTROL

MATERIAL	TEST FOR	FREQUENCY	REMARKS
NATURAL GROUND	Compaction in accordance with ASTM D 1556 or ASTM D 6938	1 per 500 square yards of surface	Conduct a minimum of 2 tests on each section.
EMBANKMENT AND/OR SUBGRADE	Soil Conditions Moisture-Density in accordance with ASTM D 698	Test 1 per soil classification	
	Compaction control in accordance with ASTM D 1556 or ASTM D 6938	1 per each lift every 300 square yards of surface	Immediately after placing, Conduct a minimum of 2 tests per section
		1 per each lift for each 100 cubic yards of fill	

END OF SECTION

SECTION 31 3700

RIP RAP

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Placement of loose riprap.
2. Placement of hand-placed riprap.

1.2 DESCRIPTION OF WORK:

A. Rip Rap construction shall consist of the hand placing of approved materials for erosion protection.

1.3 SUBMITTALS

A. Submit prior to use in the Work product data showing riprap source, gradation, aggregate wear and placement technique.

1.4 QUALITY ASSURANCE

A. Furnish each aggregate material from single source throughout Work.

B. Perform Work according to industry standards.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Riprap:

1. Durable, angular, hard stone free from seams and cracks.
2. Graded in size to produce a reasonably dense mass.
3. The greatest dimension of 25 percent of the stones shall be at least, equal to but not more than 1-1/2 times the thickness of riprap indicated.
4. The greatest dimension of 50 percent of the stone shall be at least 3/4, but not more than 1-1/2 times the thickness of riprap indicated.
5. Not more than 10 percent of the aggregate shall have a dimension less than 0.1 times the thickness of riprap.
6. At least 95 percent of the stones shall have a minimum of 2 fractured or clean angular faces.

B. Accessories

1. Geotextile fabric, Section 31 2000 Earth Moving.

C. Source Quality Control

1. Riprap: Wear not greater than 40 percent when tested, ASTM C 535.

PART 3 - EXECUTION

3.1 PREPARATION

A. Remove all brush, trees, stumps, and other objectionable materials and dress area to a smooth surface. Make Excavation to provide a firm foundation and protect against undercutting. Secure approval prior to backfilling.

B. Install required geotextile in accordance with Section 31 2000 Earth Moving.

3.2 LOOSE-PLACED RIPRAP

A. Place stones to secure a Rock mass with the minimum thickness and height indicated. Manipulate Rock to secure a regular surface of graded size and mass stability.

3.3 HAND-PLACED RIPRAP

A. Place and bed the Rocks, one against the other, and key together. Fill irregularities between stones with suitable size spalls.

B. Place so that finished surface of riprap is even, tight, and true to line and grade. Extend riprap sufficiently below ground surface to secure a firm foundation.

END OF SECTION

SECTION 32 1216
ASPHALT PAVING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Hot-mix asphalt patching.
2. Hot-mix asphalt paving.
3. Pavement-marking paint applied to asphalt pavement.

B. Related Sections:

1. Division 31 2000 Section "Earth Moving" for subgrade and aggregate base courses.
2. Geotechnical Study performed by Geomat Inc. and the report: “Geotechnical Engineering Report Navajo Nation Proposed Incident Command Center Shiprock, New Mexico” issued for this project on May 25, 2018. Geomat Inc. can be reached at phone number (505) 327-7928.

1.2 SUBMITTALS

A. Product Data: For each type of product indicated. Include technical data and tested physical and performance properties.

1. Job-Mix Designs – NMDOT Standard Specifications for Highway and Bridge Construction 2014. Certification, by authorities having jurisdiction, of approval of each job mix proposed for the Work.
2. Job-Mix Designs: For each job mix proposed for the Work.
3. Pavement Markings.

B. Material Certificates: For each paving material, from manufacturer.

C. Material Test Reports: For each paving material, by a qualified testing agency.

D. Field quality-control reports.

1.3 QUALITY ASSURANCE

A. Manufacturer Qualifications: A paving-mix manufacturer registered with and approved by the Department of Transportation of the state in which the Project is located.

B. Regulatory Requirements: Comply with materials, workmanship, and other applicable requirements of the Section 416 of NMDOT Standard Specifications for Highway and Bridge Construction 2014 for asphalt paving work.

1. Measurement and payment provisions and safety program submittals included in standard specifications do not apply to this Section.

C. Testing Agency Qualifications: Qualified according to ASTM D3666 for test indicated.

1.4 FIELD CONDITIONS

A. Environmental Limitations: Do not apply asphalt materials if subgrade is wet or excessively damp, if rain is imminent or expected before time required for adequate cure, or if the following conditions are not met:

1. Prime Coat: Minimum surface temperature of 60 degrees F.
2. Tack Coat: Minimum surface temperature of 60 degrees F.
3. Asphalt Base Course: Minimum surface temperature of 40 degrees F and rising at the time of placement.
4. Asphalt Surface Course: Minimum surface temperature of 60 degrees F at time of placement.

5. Pavement-Marking Paint: Proceed with pavement marking only on clean, dry surfaces and at a minimum ambient or surface temperature of 55 deg F for water-based materials, and not exceeding 95 deg F.

PART 2 - PRODUCTS

2.1 AGGREGATES

A. General: Use materials and gradations that have performed satisfactorily in previous installations.

B. Coarse Aggregate: ASTM D 692, sound; angular crushed stone, crushed gravel, or cured, crushed blast-furnace slag.

C. Fine Aggregate: ASTM D 1073 sharp-edged natural sand or sand prepared from stone, gravel, cured blast-furnace slag, or combinations thereof.

1. For hot-mix asphalt, limit natural sand to a maximum of 20 percent by weight of the total aggregate mass.

D. Mineral Filler: ASTM D 242 rock or slag dust, hydraulic cement, or other inert material.

2.2 ASPHALT MATERIALS

A. Asphalt Binder: AASHTO M 320 or AASHTO MP 1a, PG 64-22.

B. Tack Coat: ASTM D 977 emulsified asphalt, slow setting, diluted in water, of suitable grade and consistency for application.

C. Emulsified Asphalt Prime Coat: ASTM D 977 emulsified asphalt, or ASTM D 2397 cationic emulsified asphalt, slow setting, diluted in water, of suitable grade and consistency for application.

2.3 AUXILIARY MATERIALS

A. Herbicide: Commercial chemical for weed control, registered by the EPA, and not classified as "restricted use" for locations and conditions of application. Provide in granular, liquid, or wettable powder form.

2.4 MIXES

A. Use dry material to avoid foaming. Mix uniformly.

B. Hot-Mix Asphalt – NMDOT Mix SP-III or SP-IV per NMDOT Standard Specifications for Highway and Bridge Construction 2014. Dense, hot-laid, hot-mix asphalt plant mixes approved by authorities having jurisdiction and complying with the following requirements:

1. Provide mixes with a history of satisfactory performance in geographical area where Project is located.

2. Base Course: Per NMDOT Standard Specifications for Highway and Bridge Construction 2014.

3. Surface Course: Per NMDOT Standard Specifications for Highway and Bridge Construction 2014.

2.5 PAVEMENT MARKINGS

A. Pavement-Marking Paint: Alkyd-resin type, lead and chromate free, ready mixed, complying with AASHTO M 248, Type N, colors complying with FS TT-P-1952.

1. Color: As indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify gradients and elevations of base.

B. Proof-roll subgrade below pavements with heavy pneumatic-tired equipment to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.

C. Proceed with paving only after unsatisfactory conditions have been corrected.

3.2 EXAMINATION FOR PAVEMENT MARKING

A. Verify that pavement is dry and in suitable condition to begin pavement marking according to manufacturer's written instructions.

B. Proceed with pavement marking only after unsatisfactory conditions have been corrected.

3.3 PATCHING

A. Hot-Mix Asphalt Pavement: Saw cut perimeter of patch and excavate existing pavement section to sound base. Excavate rectangular or trapezoidal patches, extending 12 inches into adjacent sound pavement, unless otherwise indicated. Cut excavation faces vertically. Remove excavated material. Recompact existing unbound-aggregate base course to form new subgrade.

B. Tack Coat: Apply uniformly to vertical surfaces abutting or projecting into new, hot-mix asphalt paving at a rate of 0.05 to 0.10 gal/sq. yd.

1. Allow tack coat to cure undisturbed before applying hot-mix asphalt paving.
2. Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings. Remove spillages and clean affected surfaces.

C. Patching: Fill excavated pavements with hot-mix asphalt base mix for full thickness of patch and, while still hot, compact flush with adjacent surface.

3.4 SURFACE PREPARATION

A. General: Immediately before placing asphalt materials, remove loose and deleterious material from substrate surfaces. Ensure that prepared subgrade is ready to receive paving.

B. Herbicide Treatment: Apply herbicide according to manufacturer's recommended rates and written application instructions. Apply to dry, prepared subgrade or surface of compacted-aggregate base before applying paving materials.

C. Emulsified Asphalt Prime Coat: Apply uniformly over surface of compacted unbound-aggregate base course at a rate of 0.10 to 0.30 gal./sq. yd. per inch depth. Apply enough material to penetrate and seal, but not flood, surface. Allow prime coat to cure.

1. If prime coat is not entirely absorbed within 24 hours after application, spread sand over surface to blot excess asphalt. Use enough sand to prevent pickup under traffic. Remove loose sand by sweeping before pavement is placed and after volatiles have evaporated.
2. Protect primed substrate from damage until ready to receive paving.

3.5 HOT-MIX ASPHALT PLACING

A. Machine place hot-mix asphalt on prepared surface, spread uniformly, and strike off. Place asphalt mix by hand to areas inaccessible to equipment in a manner that prevents segregation of mix. Place each course to required grade, cross section, and thickness when compacted.

1. Spread mix at minimum temperature of 250 deg F
2. Regulate paver machine speed to obtain smooth, continuous surface free of pulls and tears in asphalt-paving mat.

B. Place paving in consecutive strips not less than 10 feet wide unless infill edge strips of a lesser width are required.

C. Promptly correct surface irregularities in paving course behind paver. Use suitable hand tools to remove excess material forming high spots. Fill depressions with hot-mix asphalt to prevent segregation of mix; use suitable hand tools to smooth surface.

3.6 JOINTS

A. Construct joints to ensure a continuous bond between adjoining paving sections. Construct joints free of depressions, with same texture and smoothness as other sections of hot-mix asphalt course.

1. Clean contact surfaces and apply tack coat to joints.
2. Offset longitudinal joints, in successive courses, a minimum of 6 inches.

3. Offset transverse joints, in successive courses, a minimum of 24 inches.

4. Construct transverse joints at each point where paver ends a day's work and resumes work at a subsequent time. Construct these joints using either "bulkhead" or "papered" method according to AI MS-22, for both "Ending a Lane" and "Resumption of Paving Operations."

3.7 COMPACTION

A. General: Begin compaction as soon as placed hot-mix paving will bear roller weight without excessive displacement. Compact hot-mix paving with hot, hand tampers or with vibratory-plate compactors in areas inaccessible to rollers.

1. Complete compaction before mix temperature cools to 185 deg F.

B. Breakdown Rolling: Complete breakdown or initial rolling immediately after rolling joints and outside edge. Examine surface immediately after breakdown rolling for indicated crown, grade, and smoothness. Correct laydown and rolling operations to comply with requirements.

C. Intermediate Rolling: Begin intermediate rolling immediately after breakdown rolling while hot-mix asphalt is still hot enough to achieve specified density. Continue rolling until hot-mix asphalt course has been uniformly compacted to the following density:

1. Average Density: 92 percent of reference maximum theoretical density according to ASTM D 2041, but not less than 90 percent nor greater than 96 percent.

D. Finish Rolling: Finish roll paved surfaces to remove roller marks while hot-mix asphalt is still warm.

E. Edge Shaping: While surface is being compacted and finished, trim edges of pavement to proper alignment. Bevel edges while asphalt is still hot; compact thoroughly.

F. Repairs: Remove paved areas that are defective or contaminated with foreign materials and replace with fresh, hot-mix asphalt. Compact by rolling to specified density and surface smoothness.

G. Protection: After final rolling, do not permit vehicular traffic on pavement until it has cooled and hardened.

H. Erect barricades to protect paving from traffic until mixture has cooled enough not to become marked.

3.8 INSTALLATION TOLERANCES

A. Pavement Thickness: Compact each course to produce the thickness indicated within the following tolerances:

1. Base Course: Plus or minus 1/2 inch.

2. Surface Course: Plus 1/4 inch, no minus.

B. Pavement Surface Smoothness: Compact each course to produce a surface smoothness within the following tolerances as determined by using a 12-foot straightedge applied transversely or longitudinally to paved areas:

1. Base Course: 1/4 inch.

2. Surface Course: 1/8 inch.

3. Crowned Surfaces: Test with crowned template centered and at right angle to crown. Maximum allowable variance from template is 1/4 inch.

C. Asphalt Traffic-Calming Devices: Compact and form asphalt to produce the contour indicated and within a tolerance of plus 1/4 inch of height indicated above pavement surface.

3.9 PAVEMENT MARKING

A. Do not apply pavement-marking paint until layout, colors, and placement have been verified with Architect.

B. Allow paving to age for 30 days before starting pavement marking.

C. Sweep and clean surface to eliminate loose material and dust.

D. Apply paint with mechanical equipment to produce pavement markings, of dimensions indicated, with uniform, straight edges. Apply at manufacturer's recommended rates to provide a minimum wet film thickness of 15 mils.

3.10 FIELD QUALITY CONTROL

A. Testing Agency: Contractor will engage a qualified independent testing and inspecting agency to perform field tests and inspections and to prepare test reports.

B. Thickness: In-place compacted thickness of hot-mix asphalt courses will be determined according to ASTM D 3549.

C. Surface Smoothness: Finished surface of each hot-mix asphalt course will be tested for compliance with smoothness tolerances.

D. Asphalt Traffic-Calming Devices: Finished height of traffic-calming devices above pavement will be measured for compliance with tolerances.

E. In-Place Density: Testing agency will take samples of uncompacted paving mixtures and compacted pavement according to ASTM D 979.

1. Reference maximum theoretical density will be determined by averaging results from four samples of hot-mix asphalt-paving mixture delivered daily to site, prepared according to ASTM D 2041, and compacted according to job-mix specifications.

2. In-place density of compacted pavement will be determined by testing core samples according to ASTM D 1188 or ASTM D 2726.

   a. One core sample will be taken for every 1000 sq. yd. or less of installed pavement, with no fewer than 3 cores taken.

   b. Field density of in-place compacted pavement may also be determined by nuclear method according to ASTM D 2950 and correlated with ASTM D 1188 or ASTM D 2726.

F. Replace and compact hot-mix asphalt where core tests were taken.

G. Remove and replace or install additional hot-mix asphalt where test results or measurements indicate that it does not comply with specified requirements.

3.11 DISPOSAL

A. Except for material indicated to be recycled, remove excavated materials from Project site and legally dispose of them in an EPA-approved landfill.

END OF SECTION

SECTION 32 1313
CONCRETE PAVING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes concrete paving for:

1. Concrete driveways and roadways.
2. Concrete curbs and gutters.
3. Concrete sidewalks.

B. Related Sections:

1. Section 03 3000 "Cast-in-Place Concrete" for general building applications of concrete.
2. Section 32 1373 "Concrete Paving Joint Sealants" for joint sealants in expansion and contraction joints within concrete paving and in joints between concrete paving and asphalt paving or adjacent construction.
3. Geotechnical Study performed by Geomat Inc. and the report: “Geotechnical Engineering Report Navajo Nation Proposed Incident Command Center Shiprock, New Mexico” issued for this project on May 25, 2018. Geomat Inc. can be reached at phone number (505) 327-7928.

1.2 DEFINITIONS

A. Cementitious Materials: Portland cement alone or in combination with one or more of blended hydraulic cement, and ground granulated blast-furnace slag.

1.3 SUBMITTALS

A. Product Data: For each Type of product indicated.

B. Design Mixtures:

1. For each concrete paving mixture. Include alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

C. Qualification Data: For qualified Installer of ready-mix concrete manufacturer and testing agency.

D. Material Certificates: For the following, from manufacturer:

1. Cementitious materials.
2. Steel reinforcement and reinforcement accessories.
3. Fiber reinforcement.
4. Admixtures.
5. Curing compounds.
6. Applied finish materials.
7. Bonding agent or epoxy adhesive.
8. Joint fillers.

E. Material Test Reports: For each of the following:

1. Aggregates. Include service-record data indicating absence of deleterious expansion of concrete due to alkali-aggregate reactivity.

F. Field quality-control reports.

1.4 QUALITY ASSURANCE

A. Ready-Mix-Concrete Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C94 requirements for production facilities and equipment.

1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities" (Quality Control Manual - Section 3, "Plant Certification Checklist").

B. Testing Agency Qualifications: 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.

C. Concrete Testing Service: Engage a qualified testing agency to perform material evaluation tests and to design concrete mixtures.

D. ACI Publications: Comply with ACI 301 unless otherwise indicated.

E. Preinstallation Conference: Conduct conference at Project site.

1. Review methods and procedures related to concrete paving, including but not limited to, the following:

a. Concrete mixture design.

b. Quality control of concrete materials and concrete paving construction practices.

2. Require representatives of each entity directly concerned with concrete paving to attend, including the following:

a. Contractor's superintendent.

b. Independent testing agency responsible for concrete design mixtures.

c. Ready-mix concrete manufacturer.

d. Concrete paving subcontractor.

1.5 PROJECT CONDITIONS

A. Traffic Control: Maintain access for vehicular and pedestrian traffic as required for other construction activities.

PART 2 - PRODUCTS

2.1 FORMS

A. Form Materials: Plywood, metal, metal-framed plywood, or other approved panel-type materials to provide full-depth, continuous, straight, and smooth exposed surfaces.

1. Use flexible or uniformly curved forms for curves with a radius of 100 feet or less. Do not use notched and bent forms.

B. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and that will not impair subsequent treatments of concrete surfaces.

2.2 STEEL REINFORCEMENT:

A. Reinforcing Steel: ASTM A615, 40 ksi yield grade, deformed billet bars.

B. Welded Plain Wire Fabric: ASTM A185; in flat sheets; galvanized finish.

C. Dowels: ASTM A615; 40 ksi yield strength, plain steel bars; cut to length indicated on Drawings, square ends with burrs removed.

D. Plain Steel Wire: ASTM A82, minimum 16 gage.

2.3 CONCRETE MATERIALS:

A. Cementitious Material: Use the following cementitious materials, of same type, brand, and source throughout Project:

1. ASTM C150, Type V Portland type.
2. ASTM C150, Type II Portland type with addition of with the following:
    a. Fly Ash: ASTM C 618, Class F.

B. Fine and Coarse Aggregates: ASTM C33, Class 4, uniformly graded. Provide aggregates from a single source with documented service-record data of at least 10 years' satisfactory service in similar paving applications and service conditions using similar aggregates and cementitious materials.
1. Maximum Coarse-Aggregate Size: 1-1/2 inches nominal.
2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.

C. Water: Potable and complying with ASTM C94.

D. Air Entrainment: ASTM C260.

E. Chemical Admixture: Admixtures certified by manufacturer to be compatible with other admixtures and to contain not more than 0.1 percent water-soluble chloride ions by mass of cementitious material.
1. Water Reducing Admixture: ASTM C494, Type A.
2. Retarding Admixture: ASTM C 494, Type B.
3. Water-Reducing and Retarding Admixture: ASTM C 494, Type D.
4. High-Range, Water-Reducing Admixture: ASTM C 494, Type F.
5. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494, Type G.
6. Plasticizing and Retarding Admixture: ASTM C 1017, Type II.

2.4 Curing Materials

A. Moisture-Retaining Cover: ASTM C171, polyethylene film or white burlap-polyethylene sheet.

B. Liquid Membrane-Forming Curing Compound: ASTM C309, Type 1, Class A or B.

C. Absorptive Cover: AASHTO M182, Class 3, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. dry.

2.5 RELATED MATERIALS

A. Joint Filler: Preformed durable resilient bituminous material and comply with ASTM D1751 or AASHTO M213.

2.6 CONCRETE MIXTURES

A. Prepare design mixtures, proportioned according to ACI 301, for each type and strength of normal-weight concrete, and as determined by either laboratory trial mixtures or field experience.
1. Use a qualified independent testing agency for preparing and reporting proposed concrete design mixtures for the trial batch method.
2. When automatic machine placement is used, determine design mixtures and obtain laboratory test results that meet or exceed requirements.

B. Proportion mixtures to provide normal-weight concrete with the following properties:
1. Compressive Strength at 28 days: 3,000 psi minimum.
2. Maximum Water-Cementitious Material Ratio at Point of Placement: 0.45
3. Slump: 4 inches, plus or minus 1 inch.

C. Add air-entraining admixture at manufacturer's prescribed rate to result in normal-weight concrete at point of placement having an air content as follows:
1. Air Content: 5-1/2 percent plus or minus 1.5 percent for 1-1/2-inch nominal maximum aggregate size.

2. Air Content: 6 percent plus or minus 1.5 percent for 1-inch nominal maximum aggregate size.

3. Air Content: 6 percent plus or minus 1.5 percent for 3/4-inch nominal maximum aggregate size.

D. Chemical Admixtures: Use admixtures according to manufacturer's written instructions.

1. Use water-reducing admixture in concrete as required for placement and workability.

2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.

E. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows:

1. Fly Ash or Pozzolan: 25 percent.

2.7 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, and mix concrete materials and concrete according to ASTM C 94. Furnish batch certificates for each batch discharged and used in the Work.

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. Mix concrete materials in appropriate drum-type batch plant located on or near the project site.

1. 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 EXAMINATION

A. Examine exposed subgrades and subbase surfaces for compliance with requirements for dimensional, grading, and elevation tolerances.

B. Proof-roll prepared subbase surface below concrete paving to identify soft pockets and areas of excess yielding.

1. Completely proof-roll subbase in one direction and repeat in perpendicular direction. Limit vehicle speed to 3 mph.

2. Proof-roll with a pneumatic-tired and loaded, 10-wheel, tandem-axle dump truck weighing not less than 15 tons.

3. Correct subbase with soft spots and areas of pumping or rutting exceeding depth of 1/2 inch according to requirements in Section 31 2000 Earth Moving.

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

3.2 PREPARATION

A. Remove loose material from compacted subbase surface immediately before placing concrete.

3.3 INSTALLATION

A. Edge Forms and Screed Construction

1. Set, brace, and secure edge forms, bulkheads, and intermediate screed guides to required lines, grades, and elevations. Install forms to allow continuous progress of work and so forms can remain in place at least 24 hours after concrete placement.

2. Clean forms after each use and coat with form-release agent to ensure separation from concrete without damage.

B. Steel Reinforcement

1. General: Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.
2. Clean reinforcement of loose rust and mill scale, earth, ice, or other bond-reducing materials.
3. Install welded wire reinforcement in lengths as long as practicable. Lap adjoining pieces at least one full mesh, and lace splices with wire. Offset laps of adjoining widths to prevent continuous laps in either direction.

C. Joints:

1. General: Form construction, isolation, and contraction joints and tool edges true to line, with faces perpendicular to surface plane of concrete. Construct transverse joints at right angles to centerline unless otherwise indicated.
    a. When joining existing paving, place transverse joints to align with previously placed joints unless otherwise indicated.
2. Construction Joints: Set construction joints at side and end terminations of paving and at locations where paving operations are stopped for more than one-half hour unless paving terminates at isolation joints.
    a. Continue steel reinforcement across construction joints unless otherwise indicated. Do not continue reinforcement through sides of paving strips unless otherwise indicated.
3. Isolation Joints: Form isolation joints of preformed joint-filler strips abutting concrete curbs, catch basins, manholes, inlets, structures, other fixed objects, and where indicated.
4. Expansion Joints: Expansion joints shall be constructed to the full depth and width of the concrete. The expansion joint material shall extend fully through the concrete and one inch into the subgrade with the top of the expansion joint material one-quarter inch below the top surface. Expansion joint material shall be secured in place prior to placement of concrete. Expansion joints shall be installed along all abutting structures to provide complete separation from the structure. Sidewalk, curb, and gutter expansion joints shall be installed at all radius points, at both sides of each driveway.
5. Contraction Joints: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Unless otherwise specified, the large aggregate in contraction joints shall be separated to either side of the joint for a minimum depth equal to 25% of the concrete thickness; the finished depth shall be a minimum of 3/4 inch.
6. Edging: After initial floating, all exposed edges shall be shaped with a suitable tool to form edges having the shape as indicated on the referenced detail. Repeat tooling of edges after applying surface finishes. Eliminate edging-tool marks on concrete surfaces.

D. Placing Concrete:

1. Before placing concrete, inspect and complete formwork installation, steel reinforcement, and items to be embedded or cast-in.
2. Remove snow, ice, or frost from subbase surface and steel reinforcement before placing concrete. Do not place concrete on frozen surfaces.
3. Moisten subbase to provide a uniform dampened condition at time concrete is placed. Do not place concrete around manholes or other structures until they are at required finish elevation and alignment.
4. Comply with ACI 301 requirements for measuring, mixing, transporting, and placing concrete.
5. Do not add water to concrete during delivery or at Project site. Do not add water to fresh concrete after testing.
6. Deposit and spread concrete in a continuous operation between transverse joints.

7. Do not push or drag concrete into place or use vibrators to move concrete into place. Do not disturb reinforcing or formwork components during concrete placement.
8. Consolidate concrete according to ACI 301 by mechanical vibrating equipment supplemented by hand spading, rodding, or tamping.
9. Screed paving surface with a straightedge and strike off.
10. Curbs and Gutters: Use design mixture for automatic machine placement. Produce curbs and gutters to required cross section, lines, grades, finish, and jointing.
11. Cold-Weather Placement: Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing, or low temperatures. Comply with ACI 306.1 and the following:
    a. When air temperature has fallen to or is expected to fall below 40 deg F, uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 deg F and not more than 80 deg F at point of placement.
    b. Do not use frozen materials or materials containing ice or snow.
    c. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in design mixtures.
12. Hot-Weather Placement: Comply with ACI 301 and as follows when hot-weather conditions exist:
    a. Cool ingredients before mixing to 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 in total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
    b. Cover steel reinforcement with water-soaked burlap so steel temperature will not exceed ambient air temperature immediately before embedding in concrete.
    c. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade moisture uniform without standing water, soft spots, or dry areas.

E. Finishing:
1. General: Do not add water to concrete surfaces during finishing operations.
2. Float Finish: Begin the second floating operation when bleed-water sheen has disappeared and concrete surface has stiffened sufficiently to permit operations. Float surface with power-driven floats or by hand floating if area is small or inaccessible to power units. Finish surfaces to true planes. Cut down high spots and fill low spots. Refloat surface immediately to uniform granular texture.
    a. Burlap Finish: Drag a seamless strip of damp burlap across float-finished concrete, perpendicular to line of traffic, to provide a uniform, gritty texture.
    b. Medium-to-Fine-Textured Broom Finish: Draw a soft-bristle broom across float-finished concrete surface perpendicular to line of traffic to provide a uniform, fine-line texture.
    c. Medium-to-Coarse-Textured Broom Finish: Provide a coarse finish by striating float-finished concrete surface 1/16 to 1/8 inch deep with a stiff-bristled broom, perpendicular to line of traffic.
3. Driveway and Roadway Surfaces: Light broom.
4. Sidewalk Surfaces: Light broom, trowel joint edges.
5. Curbs and Gutters: Light broom.
    a. Flow Lines: Smooth finish.
6. Apply curing compound on exposed concrete surfaces immediately after finishing.

F. Curing Methods: Cure concrete by moisture curing, moisture-retaining-cover curing, curing compound, or a combination of these as follows:

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, placed in widest practicable width, with sides and ends lapped at least 12 inches and sealed by waterproof tape or adhesive. Immediately repair any holes or tears occurring during installation or curing period using cover material and waterproof tape.
3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas that have been subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating, and repair damage during curing period.

3.4 TOLERANCES

A. Driveway and Roadway:
1. All finished concrete elevations shall not deviate from the elevations shown on the plans, or indicated by typical sections or standard details referenced within the construction documents, by more than 1/2 inch.

B. Curb and Gutter:
1. The face, top, back, and flow line of the curb and gutter shall not deviate in excess of 1/4-inch over 10 feet, as tested with a 10-foot straightedge or curve template, longitudinally along the surface.

C. Sidewalk:
1. Surface of concrete sidewalk shall not deviate in excess of 1/8-inch over 5 feet as tested with a 5-foot straightedge except for the 1/4-inch recess of the preformed material in expansion joints.

3.5 FIELD QUALITY CONTROL

A. Testing Agency: Contractor will engage a qualified testing agency to perform tests and inspections. Inspect reinforcing placement for size, spacing, location, support.

B. Testing Services: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:
1. Testing Frequency: Obtain at least one composite sample for each 100 cu. yd. or fraction thereof of each concrete mixture placed each day.
    a. When frequency of testing will provide 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; 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, pressure method; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
4. Concrete Temperature: ASTM C 1064; one test hourly when air temperature is 40 deg F and below and when it is 80 deg F and above, and one test for each composite sample.
5. Compression Test Specimens: ASTM C 31; cast and laboratory cure one set of three standard cylinder specimens for each composite sample.
6. Compressive-Strength Tests: ASTM C 39; test one specimen at seven days and two specimens at 28 days.

a. A compressive-strength test shall be the average compressive strength from two specimens obtained from same composite sample and tested at 28 days.

C. Strength of each concrete mixture will be satisfactory if 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.

D. 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.

E. 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.

F. 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.

G. Concrete paving will be considered defective if it does not pass tests and inspections.

H. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

I. Prepare test and inspection reports.

3.6 REPAIRS AND PROTECTION

A. Remove and replace concrete paving that is broken, damaged, or defective or that does not comply with requirements in this Section. Remove work in complete sections from joint to joint unless otherwise approved by Architect.

B. Drill test cores, where directed by Architect, when necessary to determine magnitude of cracks or defective areas. Fill drilled core holes in satisfactory paving areas with portland cement concrete bonded to paving with epoxy adhesive.

C. Protect concrete paving from damage. Exclude traffic from paving for at least 14 days after placement. When construction traffic is permitted, maintain paving as clean as possible by removing surface stains and spillage of materials as they occur.

D. Maintain concrete paving free of stains, discoloration, dirt, and other foreign material. Sweep paving not more than two days before date scheduled for Substantial Completion inspections.

END OF SECTION

SECTION 321316 - DECORATIVE CONCRETE PAVING

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. Geotechnical Evaluation for SRPMIC Cultural Repository.

1.2 SUMMARY

A. Section includes colored, stamped, stenciled and stained concrete paving.

B. Related Sections:

1. Section 033000 "Cast-in-Place Concrete" for general building applications of concrete.
2. Section 033300 "Architectural Concrete" for general building applications of specially finished formed concrete.
3. Section 321313 "Concrete Paving" for cast-in-place concrete paving with other finishes, curbs and gutters, stamped detectable warnings, pavement markings, and wheel stops.
4. Section 321373 "Concrete Paving Joint Sealants" for joint sealants in expansion and contraction joints within decorative concrete paving and in joints between decorative concrete paving and asphalt paving or adjacent construction.

1.3 DEFINITIONS

A. Cementitious Materials: Portland cement alone or in combination with one or more of blended hydraulic cement, fly ash and other pozzolans, and ground granulated blast-furnace slag.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of manufactured material and product indicated.

B. Samples for Initial Selection: For each type of product, ingredient, or admixture requiring color, pattern, or texture selection.

C. Samples for Verification: For each type of exposed color, pattern, or texture indicated.

D. Other Action Submittals:

1. Design Mixtures: For each decorative concrete paving mixture. Include alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer of detectable warnings, ready-mix concrete manufacturer and testing agency.

B. Material Certificates: For the following, from manufacturer:

1. Cementitious materials.
2. Steel reinforcement and reinforcement accessories.
3. Fiber reinforcement.
4. Admixtures.
5. Curing compounds.
6. Applied finish materials.
7. Bonding agent or epoxy adhesive.
8. Joint fillers.

C. Material Test Reports: For each of the following:

1. Aggregates. Include service-record data indicating absence of deleterious expansion of concrete due to alkali-aggregate reactivity.

D. Field quality-control reports.

E. Minutes of pre-installation conference.

1.6 QUALITY ASSURANCE

A. Concrete Standards: Comply with provision of the following standards, except where more stringent requirements are indicated.

1. American Concrete Institute (ACI) 301, Specifications for Structural Concrete for Buildings.
2. American Concrete Institute (ACI) 318, “Building Code Requirements for Reinforced Concrete.”
3. Concrete Reinforcing Steel Institute (CRSI) “ Manual of Standard Practice”

B. Installer Qualifications: An employer of workers trained and approved by manufacturer of decorative concrete paving systems.

C. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Build mockups of full-thickness sections of decorative concrete paving to demonstrate typical joints; surface color, pattern, and texture; curing; and standard of workmanship.
2. Build mockups of decorative concrete paving in the location and of the size indicated or, if not indicated, build mockups where directed by Architect and not less than 4’ by 4’.
3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
4. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

D. Pre-installation Conference: Conduct conference at project site.

1. Review methods and procedures related to decorative concrete paving, including but not limited to, the following:

    a. Concrete mixture design.
    b. Quality control of concrete materials and decorative concrete paving construction practices.

2. Require representatives of each entity directly concerned with decorative concrete paving to attend, including the following:

    a. Contractor's superintendent.
    b. Independent testing agency responsible for concrete design mixtures.
    c. Ready-mix concrete manufacturer.
    d. Decorative concrete paving Installer.

1.7 PROJECT CONDITIONS

A. Traffic Control:

1. Maintain access for vehicular and pedestrian traffic as required for other construction activities.
2. Minimize interference with adjoining roads, street, walks, and other adjacent occupied or used facilities during site-clearing operations.
3. Do not close or obstruct street, walks, or other adjacent occupied or used facilities without permission from the Owner’s Representative and the governing agencies.
4. Provide alternative routes around closed or obstructed pedestrian and traffic ways, as required by the Owner’s Representative or the governing agencies, including temporary ADA accessibility.

PART 2 - PRODUCTS

2.1 FORMS

A. Form Materials: Plywood, metal, metal-framed plywood, or other approved panel-type materials to provide full-depth, continuous, straight, and smooth exposed surfaces.

1. Use flexible or uniformly curved forms for curves of a radius of 100 feet (30.5 m) or less. Do not use notched and bent forms.

B. Forms for Textured Finish Concrete: Units of face design, size, arrangement, and configuration indicated. Provide solid backing and form supports to ensure stability of textured form liners.

C. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and that will not impair subsequent treatments of concrete surfaces.

2.2 STEEL REINFORCEMENT

A. Plain-Steel Welded Wire Reinforcement: ASTM A 185/A 185M, fabricated from as-drawn steel wire into flat sheets.

B. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (Grade 420); deformed.

C. Steel Bar Mats: ASTM A 184/A 184M; with ASTM A 615/A 615M, Grade 60 (Grade 420), deformed bars; assembled with clips.

D. Plain-Steel Wire: ASTM A 82/A 82M, as drawn.

E. Joint Dowel Bars: ASTM A 615/A 615M, Grade 60 (Grade 420) plain-steel bars. Cut bars true to length with ends square and free of burrs.

F. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars, welded wire reinforcement, and dowels in place. Manufacture bar supports according to CRSI's "Manual of Standard Practice" from steel wire, plastic, or precast concrete of greater compressive strength than concrete specified, and as follows:

1. Equip wire bar supports with sand plates or horizontal runners where base material will not support chair legs.

2.3 CONCRETE MATERIALS

A. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source, throughout Project:

1. Portland Cement: ASTM C 150, gray portland Type V.

B. Normal-Weight Aggregates: ASTM C 33, Class 4S, uniformly graded. Provide aggregates from a single source with documented service-record data of at least 10 years' satisfactory service in similar paving applications and service conditions using similar aggregates and cementitious materials.

1. Maximum Aggregate Size: 1 inch (25 mm)] nominal.
2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.

C. Water: Potable and complying with ASTM C 94/C 94M.

D. Air-Entraining Admixture: ASTM C 260.

E. Chemical Admixtures: Admixtures certified by manufacturer to be compatible with other admixtures and to contain not more than 0.1 percent water-soluble chloride ions by mass of cementitious material.

1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A, colored.
2. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D, colored.
3. Water-Reducing and Accelerating Admixture: ASTM C 494/C 494M, Type E.

F. Color Pigment: ASTM C 979, synthetic mineral-oxide pigments or colored water-reducing admixtures; color stable, free of carbon black, nonfading, and resistant to lime and other alkalis.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Scofield, L. M. Company; CHROMIX Admixture, www.scolfield.com
   b. Or approved equal

2.4 RELATED MATERIALS

A. Joint Fillers: ASTM D 1751, asphalt-saturated cellulosic fiber or ASTM D 1752, cork or self-expanding cork in preformed strips.

B. Bonding Agent: ASTM C 1059, Type II, non-redispersible, acrylic emulsion or styrene butadiene.

C. Epoxy Bonding Adhesive: ASTM C 881/C 881M, two-component epoxy resin capable of humid curing and bonding to damp surfaces; of class suitable for application temperature, of grade complying with requirements, and of the following types:

1. Types I and II, non-load bearing, Types IV and V, load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.

D. Polyethylene Film: ASTM D 4397, 1 mil (0.025 mm) thick, clear.

2.5 CONCRETE MIXTURES

A. Prepare design mixtures, proportioned according to ACI 301 (ACI 301M), for each type and strength of normal-weight concrete, and as determined by either laboratory trial mixtures or field experience.

1. Use a qualified independent testing agency for preparing and reporting proposed concrete design mixtures for the trial batch method.

B. Proportion mixtures to provide normal-weight concrete with the following properties:

1. Compressive Strength (28 Days): 4500 psi (31 MPa).
2. Maximum Water-Cementitious Materials Ratio at Point of Placement: 0.50
3. Slump Limit: 4 inches (100 mm) plus or minus 1 inch (25 mm).

C. Add air-entraining admixture at manufacturer's prescribed rate to result in normal-weight concrete at point of placement having an air content as follows:

1. Air Content: 5-1/2 percent plus or minus 1.5 percent for 1-1/2-inch (38-mm) nominal maximum aggregate size.
2. Air Content: 6 percent plus or minus 1.5 percent for 1-inch (25-mm) nominal maximum aggregate size.
3. Air Content: 6 percent plus or minus 1.5 percent for 3/4-inch (19-mm) nominal maximum aggregate size.

D. Chemical Admixtures: Admixures certified by manufactuer to be compatible with other admixtures and to contain not more than 0.1 percent water-soluble chloride ions by mass of cementitious material.

E. Cementitious Materials: Use pozzolan as needed to reduce the total amount of portland cement, which would otherwise be used, by not less than 40 percent. Limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows:

1. Pozzolan: 25 percent.

F. Color Pigment: Add color pigment to concrete mixture according to manufacturer's written instructions and to result in hardened concrete color consistent with approved mockup.

2.6 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, and mix concrete materials and concrete according to ASTM C 94/C 94M and ASTM C 1116/C 1116M. Furnish batch certificates for each batch discharged and used in the Work.

1. When air temperature is between 85 and 90 deg F (30 and 32 deg C), reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F (32 deg C), 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 concrete batches of 1 cu. yd. (0.76 cu. m) 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 concrete batches larger than 1 cu. yd. (0.76 cu. m), increase mixing time by 15 seconds for each additional 1 cu. yd. (0.76 cu. m).
3. Provide batch ticket for each batch discharged and used in the Work, indicating Project identification name and number, date, mixture type, mixing time, quantity, and amount of water added.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine exposed subgrades and subbase surfaces for compliance with requirements for dimensional, grading, and elevation tolerances.

B. Proof-roll prepared subbase surface below decorative concrete paving to identify soft pockets and areas of excess yielding.

1. Completely proof-roll subbase in one direction and repeat in perpendicular direction. Limit vehicle speed to 3 mph (5 km/h).
2. Proof-roll with a pneumatic-tired and loaded, 10-wheel, tandem-axle dump truck weighing not less than 15 tons (13.6 tonnes).
3. Correct subbase with soft spots and areas of pumping or rutting exceeding depth of 1/2 inch (13 mm) according to requirements in Section 312000 "Earth Moving."

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

3.2 PREPARATION

A. Remove loose material from compacted subbase surface immediately before placing concrete.

B. Protect adjacent construction from discoloration and spillage during application of color hardeners, release agents, stains, curing compounds, and sealers.

3.3 EDGE FORMS AND SCREED CONSTRUCTION

A. Set, brace, and secure edge forms, bulkheads, and intermediate screed guides to required lines, grades, and elevations. Install forms to allow continuous progress of work and so forms can remain in place at least 24 hours after concrete placement.

B. Clean forms after each use and coat with form-release agent to ensure separation from concrete without damage.

3.4 STEEL REINFORCEMENT

A. General: Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.

B. Clean reinforcement of loose rust and mill scale, earth, ice, or other bond-reducing materials.

C. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during concrete placement. Maintain minimum cover to reinforcement.

D. Install welded wire reinforcement in lengths as long as practicable. Lap adjoining pieces at least one full mesh, and lace splices with wire. Offset laps of adjoining widths to prevent continuous laps in either direction.

E. Install fabricated bar mats in lengths as long as practicable. Handle units to keep them flat and free of distortions. Straighten bends, kinks, and other irregularities, or replace units as required before placement. Set mats for a minimum 2-inch (50-mm) overlap to adjacent mats.

3.5 JOINTS

A. General: Form construction, isolation, and contraction joints and tool edges true to line, with faces perpendicular to surface plane of concrete. Construct transverse joints at right angles to centerline unless otherwise indicated.

1. When joining existing paving, place transverse joints to align with previously placed joints unless otherwise indicated.

B. Construction Joints: Set construction joints at side and end terminations of paving and at locations where paving operations are stopped for more than one-half hour unless paving terminates at isolation joints.

1. Continue steel reinforcement across construction joints unless otherwise indicated. Do not continue reinforcement through sides of paving strips unless otherwise indicated.
2. Butt Joints: Use epoxy bonding adhesive at joint locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
3. Keyed Joints: Provide preformed keyway-section forms or bulkhead forms with keys unless otherwise indicated. Embed keys at least 1-1/2 inches (38 mm) into concrete.
4. Dowelled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or coat with asphalt one-half of dowel length to prevent concrete bonding to one side of joint.

C. Isolation Joints: Form isolation joints of preformed joint-filler strips abutting concrete curbs, catch basins, manholes, inlets, structures, walks, other fixed objects, and where indicated.

1. Locate expansion joints at intervals of 50 feet (15.25 m) unless otherwise indicated.
2. Extend joint fillers full width and depth of joint.
3. Terminate joint filler not less than 1/2 inch (13 mm) or more than 1 inch (25 mm) below finished surface if joint sealant is indicated.
4. Place top of joint filler flush with finished concrete surface if joint sealant is not indicated.
5. Furnish joint fillers in one-piece lengths. Where more than one length is required, lace or clip joint-filler sections together.
6. During concrete placement, protect top edge of joint filler with metal, plastic, or other temporary preformed cap. Remove protective cap after concrete has been placed on both sides of joint.

D. Contraction Joints: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of the concrete thickness, as follows, to match jointing of existing adjacent decorative concrete paving:

1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint with grooving tool to a 3/8-inch (10-mm) radius. Repeat grooving of contraction joints after applying surface finishes. Eliminate grooving-tool marks on concrete surfaces.

    a. Tolerance: Ensure that grooved joints are within 3 inches (75 mm) either way from centers of dowels.

2. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch- (3-mm-) wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before developing random contraction cracks.

    a. Tolerance: Ensure that sawed joints are within 3 inches (75 mm) in both directions from center of dowels.

3. Doweled Contraction Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or coat with asphalt one-half of dowel length to prevent concrete bonding to one side of joint.

E. Edging: After initial floating, tool edges of paving, gutters, curbs, and joints in concrete with an edging tool to a 3/8-inch (10-mm) radius. Repeat tooling of edges after applying surface finishes. Eliminate edging tool marks on concrete surfaces.

3.6 CONCRETE PLACEMENT

A. Before placing concrete, inspect and complete formwork installation, steel reinforcement, and items to be embedded or cast-in.

B. Remove snow, ice, or frost from subbase surface and steel reinforcement before placing concrete. Do not place concrete on frozen surfaces.

C. Moisten subbase to provide a uniform dampened condition at time concrete is placed. Do not place concrete around manholes or other structures until they are at required finish elevation and alignment.

D. Comply with ACI 301 requirements for measuring, mixing, transporting, and placing concrete.

E. Do not add water to concrete during delivery or at Project site. Do not add water to fresh concrete after testing.

F. Deposit and spread concrete in a continuous operation between transverse joints. Do not push or drag concrete into place or use vibrators to move concrete into place.

G. Consolidate concrete according to ACI 301 by mechanical vibrating equipment supplemented by hand spading, rodding, or tamping.

1. Consolidate concrete along face of forms and adjacent to transverse joints with an internal vibrator. Keep vibrator away from joint assemblies, reinforcement, or side forms. Use only square-faced shovels for hand spreading and consolidation. Consolidate with care to prevent dislocating reinforcement and joint devices.

H. Screed paving surface with a straightedge and strike off.

I. Commence initial floating using bull floats or darbies to impart an open-textured and uniform surface plane before excess moisture or bleed water appears on the surface. Do not further disturb concrete surfaces before beginning finishing operations or spreading surface treatments.

J. Cold-Weather Placement: Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing, or low temperatures. Comply with ACI 306.1 and the following:

1. When air temperature has fallen to or is expected to fall below 40 deg F (4.4 deg C), uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 deg F (10 deg C) and not more than 80 deg F (27 deg C) at point of placement.
2. Do not use frozen materials or materials containing ice or snow.
3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in design mixtures.
4. During Cold-Weather Months from October to March Contractor shall notify Architect of Cold-Weather Placement conditions prior to implementation.

K. Hot-Weather Placement: Comply with ACI 301 and as follows when hot-weather conditions exist:

1. Cool ingredients before mixing to maintain concrete temperature below 90 deg F (32 deg C) at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated in total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
2. Cover steel reinforcement with water-soaked burlap so steel temperature will not exceed ambient air temperature immediately before embedding in concrete.
3. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade moisture uniform without standing water, soft spots, or dry areas.

3.7 FLOAT FINISHING

A. General: Do not add water to concrete surfaces during finishing operations.

B. Float Finish: Begin the second floating operation when bleed-water sheen has disappeared and concrete surface has stiffened sufficiently to permit operations. Float surface with power-driven floats or by hand floating if area is small or inaccessible to power units. Finish surfaces to true planes. Cut down high spots and fill low spots. Refloat surface immediately to uniform granular texture.

3.8 INTEGRALLY COLORED CONCRETE FINISH

A. Integrally Colored Concrete Finish: Surfaces shall be finished uniformly with the following finish:

1. Broomed: Pull broom across freshly floated concrete to produce a coarse finish 1/16 to 1/8 inch (1.6 to 3 mm) deep with a stiff-bristled broom, perpendicular to line of traffic. Coarse texture in straight lines perpendicular to main line of traffic. Do not dampen brooms.

2. Swirl: Float concrete. Work float flat on surface using pressure in swirling manner to produce series of uniform arcs and twists. Use wood float to provide coarse texture.

3. Trowel: Precautions should be taken to ensure that the surface is uniformly troweled so that it will not be slippery. Do not over-trowel or burnish the surface.

4. Rock Salt: Float and broom concrete. Then sprinkle salt on concrete and press into surface leaving only tops of salt grains exposed. After 24 hours, wash salt away with water and brush. Allow surface and impressions to dry before applying curing compound.

5. Power Washed Exposed Aggregate: Finish concrete and apply chemical surface retarder according to manufacturer’s written instructions. Use power washer on float-finished concrete to expose aggregates in concrete surface.

3.9 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. Evaporation Retarder: Apply evaporation retarder to concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h (1 kg/sq. m 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.

D. Begin curing after finishing concrete but not before free water has disappeared from concrete surface.

E. Curing Compound: Apply curing compound immediately after final finishing. Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas that have been subjected to heavy rainfall within three hours after application. Maintain continuity of coating, and repair damage during curing period.

1. Cure integrally colored concrete with a[pigmented] curing compound.
2. Cure concrete finished with pigmented mineral dry-shake hardener with a[pigmented] curing compound.

F. Curing and Sealing Compound: Apply uniformly in 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.

G. Curing Paper: Cure with unwrinkled curing paper in pieces large enough to cover the entire width and edges of slab. Do not lap sheets. Fold curing paper down over paving edges and secure

with continuous banks of earth to prevent displacement or billowing due to wind. Immediately repair holes or tears in paper.

3.10 SEALER

A. Clear Acrylic Sealer: Apply uniformly in two coats in continuous operations according to manufacturer's written instructions. Allow first coat to dry before applying second coat, at 90 degrees to the direction of the first coat using same application methods and rates.

1. Begin sealing dry surface no sooner than 14 days after concrete placement.
2. Allow stained concrete surfaces to dry before applying sealer.
3. Thoroughly mix slip-resistance-enhancing additive into sealer before applying sealer according to manufacturer's written instructions. Stir sealer occasionally during application to maintain even distribution of additive.

3.11 PAVING TOLERANCES

A. Comply with tolerances in ACI 117 and as follows:

1. Elevation: 3/4 inch (19 mm).
2. Thickness: Plus 3/8 inch (10 mm), minus 1/4 inch (6 mm).
3. Surface: Gap below 10-foot- (3-m-) long, unleveled straightedge not to exceed 1/2 inch (13 mm).
4. Lateral Alignment and Spacing of Dowels: 1 inch (25 mm).
5. Vertical Alignment of Dowels: 1/4 inch (6 mm).
6. Alignment of Dowel-Bar End Relative to Line Perpendicular to Paving Edge: 1/4 inch per 12 inches (6 mm per 300 mm) of dowel.
7. Joint Spacing: 3 inches (75 mm).
8. Contraction Joint Depth: Plus 1/4 inch (6 mm), no minus.
9. Joint Width: Plus 1/8 inch (3 mm), no minus.

3.12 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Testing Services: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:

1. Testing Frequency: Obtain at least one composite sample for each 5000 sq. ft. (465 sq. m) or fraction thereof of each concrete mixture placed each day.

    a. When frequency of testing will provide 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, pressure method; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.

4. Concrete Temperature: ASTM C 1064/C 1064M; one test hourly when air temperature is 40 deg F (4.4 deg C) and below and when it is 80 deg F (27 deg C) and above, and one test for each composite sample.
5. Compression Test Specimens: ASTM C 31/C 31M; cast and laboratory cure one set of three standard cylinder specimens for each composite sample.
6. Compressive-Strength Tests: ASTM C 39/C 39M; test one specimen at seven days and two specimens at 28 days.

    a. A compressive-strength test shall be the average compressive strength from two specimens obtained from same composite sample and tested at 28 days.

C. Strength of each concrete mixture will be satisfactory if 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 (3.4 MPa).

D. 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.

E. 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.

F. 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.

G. Decorative concrete paving will be considered defective if it does not pass tests and inspections.

H. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

I. Prepare test and inspection reports.

3.13 REPAIRS AND PROTECTION

A. Remove and replace decorative concrete paving that is broken or damaged or does not comply with requirements in this Section. Remove work in complete sections from joint to joint unless otherwise approved by Architect.

B. Detailing: Grind concrete "squeeze" left from tool placement. Color ground areas with slurry of color hardener mixed with water and bonding agent. Remove excess release agent with high-velocity blower.

C. Protect decorative concrete paving from damage. Exclude traffic from paving for at least 14 days after placement. When construction traffic is permitted, maintain paving as clean as possible by removing surface stains and spillage of materials as they occur.

D. Maintain decorative concrete paving free of stains, discoloration, dirt, and other foreign material. Sweep paving not more than two days before date scheduled for Substantial Completion inspections.

3.14 DECORATIVE CONCRETE SCHEDULE

A. Decorative Concrete Paving and Patterning:

1. Locations: Install per Landscape Plan and Architectural Plan
2. Coloring Method: INTEGRALLY COLORED CONCRETE: Davis Colors specified or approved alternative:

    a. Color: As indicated on Sheet L101, Decorative Concrete Schedule:
        1) DC 1 – Davis Colors “Santa Fe” (Salted Finish)
        2) DC 2 – Davis Colors “Dark Grey” (Heavy Broom Finish)

END OF SECTION

SECTION 32 1373
CONCRETE PAVING JOINT SEALANTS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes cold and hot-applied pavement joint sealants in the following locations:

1. Portland Cement concrete pavement expansion and contraction joints.
2. Joints between Portland Cement concrete and asphalt pavement

1.2 SUBMITTALS

A. Product Data: For each type of product.

B. Samples: For each kind and color of joint sealant required.

C. Product test reports.

D. Sealant compatibility and adhesion test reports.

1.3 QUALITY ASSURANCE

A. Sealant Compatibility and Adhesion Testing: Use sealant manufacturer's standard test methods to determine whether priming and other specific joint preparation techniques are required to obtain rapid, optimum adhesion of joint sealants to joint substrates.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the products specified.
2. Products: Subject to compliance with requirements, provide one of the products specified.

2.2 GENERAL, MATERIALS

A. Compatibility: Provide joint sealants, backing materials, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer, based on testing and field experience.

1. Primers: Product recommended in writing by joint sealant manufacturer for adhesion of sealant to joint substrates indicated, as determined from sealant compatibility and adhesion tests and prior experience.

B. Joint-Sealant Backer Materials: Nonstaining; compatible with joint substrates, sealants, primers, and other joint fillers; and approved for applications indicated by joint sealant manufacturer based on field experience and laboratory testing.

1. Round Backer Rod for Cold- and Hot-Applied Sealants: ASTM D 5249, Type 1, of diameter and density required to control sealant depths and prevent bottom-side adhesion of sealant.
2. Backer Strips for Cold- and Hot-Applied Sealants: ASTM D 5249; Type 2; of thickness and width required to control sealant depths, prevent bottom-side adhesion of sealant, and fill remainder of joint opening under sealant.
3. Round Backer Rods for Cold-Applied Sealants: ASTM D 5249, Type 3, of diameter and density required to control sealant depths and prevent bottom-side adhesion of sealant.

2.3 COLD-APPLIED JOINT SEALANTS

A. Multicomponent Jet-Fuel-Resistant Sealant for Concrete: ASTM C 920, pourable, chemically curing elastomeric formulation.

1. Urethane Formulation: Type M; Grade P; Class 12-1/2; Uses T, M, and, as applicable to joint substrates indicated, O.
    a. Products:
        1) Pecora Corporation; Urexpan NR-300.
        2) Engineer Approved.
2. Coal-Tar-Modified Polymer Formulation: Type M; Grade P; Class 25; Uses T and, as applicable to joint substrates indicated, O.
    a. Products:
        1) Meadows, W. R., Inc.; SEALTIGHT GARDOX.
        2) Engineer Approved.
3. Bitumen-Modified Urethane Formulation: Type M; Grade P; Class 25; Uses T, M, and, as applicable to joint substrates indicated, O.
    a. Products:
        1) Mameco International; Vulkem 202.
        2) Sonneborn Building Products Div., ChemRex, Inc.; Sonomeric 2.
        3) Engineer Approved.

B. Nonsag Silicone Sealant for Concrete: ASTM D 5893, Type NS, single-component, low-modulus, neutral-curing, nonsag silicone sealant.
    1. Products:
        a. Crafco Inc.; Roadsaver Silicone-SL.
        b. Dow Corning; 888.
        c. Engineer Approved.

C. Self-Leveling Silicone Sealant for Concrete and Asphalt: ASTM D 5893, Type SL, single-component, low-modulus, neutral-curing, self-leveling silicone sealant.
    1. Products:
        a. Dow Corning; 890-SL.
        b. Engineer Approved.

D. Multicomponent Low-Modulus Sealant for Concrete and Asphalt: Proprietary, pourable, self-leveling formulation of reactive petropolymer and activator.
    1. Products:
        a. Meadows, W. R., Inc.; SOF-SEAL.
        b. Engineer Approved.

2.4 HOT-APPLIED JOINT SEALANTS

A. Elastomeric Sealant for Concrete: ASTM D 3406.
    1. Products:
        a. Crafco, Inc.; Superseal 444/777.
        b. Meadows, W. R., Inc.; POLY-JET 3406.
        c. Engineer Approved.

B. Sealant for Concrete and Asphalt: ASTM D 3405.
    1. Products:
        a. Crafco Inc.; ROADSAVER 221.
        b. Koch Materials Company; Product #9005.
        c. Meadows, W. R., Inc.; SEALTIGHT HI-SPEC.

d. Engineer Approved.

PART 3

3.1 INSTALLATION

A. Clean out joints immediately before installing joint sealants.

B. Joint Priming: Prime joint substrates where indicated or recommended in writing by joint sealant manufacturer, based on sealant compatibility and adhesion tests and prior experience. Confine primers to areas of joint-sealant bond; do not spill primers or allow them to migrate onto adjoining surfaces.

C. Sealant Installation: Comply with applicable recommendations in ASTM C 1193.

D. Install backer materials to support sealants during application and at position required to produce optimum sealant movement capability.

1. Do not leave gaps between ends of backer materials.
2. Do not stretch, twist, puncture, or tear backer materials.
3. Remove absorbent backer materials that have become wet before sealant application and replace them with dry materials

E. Install sealants at same time backer materials are installed.

1. Place sealants so they directly contact and fully wet joint substrates.
2. Completely fill recesses provided for each joint configuration.
3. Produce uniform, cross-sectional shapes and depths optimze sealant movement capability.

F. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants 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 sealants from surfaces adjacent to joint.
2. Use tooling agents that are approved in writing by joint sealant manufacturer and that do not discolor sealants or adjacent surfaces.

G. Clean excess sealants or sealant smears adjacent to joints as installation progresses by methods and with cleaning materials approved by manufacturers of joint sealants and of products in which joints occur.

END OF SECTION

SECTION 32 1713 - PARKING BUMPERS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Precast concrete parking bumpers and anchorage.

1.02 REFERENCE STANDARDS

A. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement; 2016.

B. ASTM C150/C150M - Standard Specification for Portland Cement; 2016.

C. ASTM C260/C260M - Standard Specification for Air-Entraining Admixtures for Concrete; 2010a (Reapproved 2016).

D. ASTM C330/C330M - Standard Specification for Lightweight Aggregates for Structural Concrete; 2017a.

PART 2 PRODUCTS

2.01 MATERIALS

A. Parking Bumpers: Precast concrete, conforming to the following:
   1. Cement: ASTM C150/C150M, Portland Type I - Normal; white color.
   2. Concrete Materials: ASTM C330/C330M aggregate, water, and sand.
   3. Reinforcing Steel: ASTM A615/A615M, deformed steel bars; unfinished, strength and size commensurate with precast unit design.
   4. Air Entrainment Admixture: ASTM C260/C260M.
   5. Concrete Mix: Minimum 5,000 psi compressive strength after 28 days, air entrained to 5 to 7 percent.
   6. Use rigid molds, constructed to maintain precast units uniform in shape, size and finish. Maintain consistent quality during manufacture.
   7. Embed reinforcing steel, and drill or sleeve for two dowels.
   8. Cure units to develop concrete quality, and to minimize appearance blemishes such as non-uniformity, staining, or surface cracking.
   9. Minor patching in plant is acceptable, providing appearance of units is not impaired.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install units without damage to shape or finish. Replace or repair damaged units.

B. Install units in alignment with adjacent work.

C. Fasten units in place with 2 dowels per unit.

END OF SECTION

SECTION 32 1713
PARKING SAFETY CURB

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes safety curb.

B. Precast concrete safety curb.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples: For each exposed product and for each color and texture specified.

1.3 QUALITY ASSURANCE

A. Perform Work according to Maricopa Association of Governments (MAG) Uniform Standard Specifications and Details for Public Works Construction.

PART 2 - PRODUCTS

2.1 CONCRETE BUMPERS

A. Cement: ASTM C150, portland Type II.

B. Concrete Materials: ASTM C33; water and sand.

C. Reinforcing Steel: ASTM A615, 40 ksi yield grade, deformed billet bars, strength and size commensurate with precast unit design.

D. Air Entrainment Admixture: ASTM C260.

E. Concrete Mix: Minimum 3,000 psi, 28-day strength.

F. Use rigid molds, constructed to maintain precast units uniform in shape, size and finish. Maintain consistent quality during manufacture.

G. Embed reinforcing steel, and drill or sleeve for two dowels.

H. Cure units to develop concrete quality, and to minimize appearance blemishes including non-uniformity, staining, or surface cracking.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Install safety curb according to manufacturer's written instructions unless otherwise indicated.

B. Install safety curb in bed of adhesive before anchoring.

C. Securely anchor safety curb to pavement with hardware in each preformed vertical hole in safety curb as recommended in writing by manufacturer.

END OF SECTION

SECTION 32 1723.13 - PAINTED PAVEMENT MARKINGS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Parking lot markings, including parking bays, crosswalks, arrows, handicapped symbols, and curb markings.

B. Roadway lane markings and crosswalk markings.

C. "No Parking" curb painting.

1.02 RELATED REQUIREMENTS

A. Section 32 1216 - Asphalt Paving.

B. Section 32 1313 - Concrete Paving.

1.03 REFERENCE STANDARDS

A. MPI (APL) - Master Painters Institute Approved Products List; Master Painters and Decorators Association; Current Edition.

B. FHWA MUTCD - Manual on Uniform Traffic Control Devices for Streets and Highways; U.S. Department of Transportation, Federal Highway Administration; Current Edition.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Manufacturer's data sheets on each product to be used, including:
   1. Preparation instructions and recommendations.
   2. Storage and handling requirements and recommendations.
   3. Installation methods.

C. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 01 6000 - Product Requirements, for additional provisions.
   2. Extra Paint: 2 containers, 1 gallon size, of each type and color.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Deliver paint in containers of at least 5 gallons accompanied by batch certificate.

B. Store products in manufacturer's unopened packaging until ready for installation.

C. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.

PART 2 PRODUCTS

2.01 MATERIALS

A. Line and Zone Marking Paint: MPI (APL) No. 97 Latex Traffic Marking Paint; color(s) as indicated.
   1. Roadway Markings: As required by authorities having jurisdiction.
   2. Parking Lots: Yellow.
   3. Handicapped Symbols: Blue.
   4. Curb "No Parking" Text: Yellow
   5. Curb Pait for no Parking zone: Red
   6. Asphalt "No Parking"Area designation: Red

B. Confirm all color with Authority Having Jurisdiction prior to installation.

C. See plans for locations / designation of markings.

D. Temporary Marking Tape: Preformed, reflective, pressure sensitive adhesive tape in color(s) required; Contractor is responsible for selection of material of sufficient durability as to perform satisfactorily during period for which its use is required.

PART 3 EXECUTION

3.01 EXAMINATION

A. Do not begin installation until substrates have been properly prepared.

B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.02 PREPARATION

A. Allow new pavement surfaces to cure for a period of not less than 14 days before application of marking materials.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

C. Clean surfaces thoroughly prior to installation.
   1. Remove dust, dirt, and other granular surface deposits by sweeping, blowing with compressed air, rinsing with water, or a combination of these methods.

D. Where oil or grease are present, scrub affected areas with several applications of trisodium phosphate solution or other approved detergent or degreaser, and rinse thoroughly after each application; after cleaning, seal oil-soaked areas with cut shellac to prevent bleeding through the new paint.

E. Establish survey control points to determine locations and dimensions of markings; provide templates to control paint application by type and color at necessary intervals.

F. Temporary Pavement Markings: When required or directed by Architect, apply temporary markings of the color(s), width(s) and length(s) as indicated or directed.
   1. After temporary marking has served its purpose, remove temporary marking by carefully controlled sandblasting, approved grinding equipment, or other approved method so that surface to which the marking was applied will not be damaged.
   2. At Contractor's option, temporary marking tape may used in lieu of temporary painted marking; remove unsatisfactory tape and replace with painted markings at no additional cost to Owner.

3.03 INSTALLATION

A. Begin pavement marking as soon as practicable after surface has been cleaned and dried.

B. Do not apply paint if temperature of surface to be painted or the atmosphere is less than 50 degrees F or more than 95 degrees F.

C. Apply in accordance with manufacturer's instructions using an experienced technician that is thoroughly familiar with equipment, materials, and marking layouts.

D. Comply with FHWA MUTCD manual (http://mutcd.fhwa.dot.gov) for details not shown.

E. Apply markings in locations determined by measurement from survey control points; preserve control points until after markings have been accepted.

F. Apply uniformly painted markings of color(s), lengths, and widths as indicated on drawings true, sharp edges and ends.
   1. Apply paint in one coat only.
   2. Wet Film Thickness: 0.015 inch, minimum.
   3. Width Tolerance: Plus or minus 1/8 inch.

G. Roadway Traffic Lanes: Use suitable mobile mechanical equipment that provides constant agitation of paint and travels at controlled speeds.
   1. Conduct operations in such a manner that necessary traffic can move without hindrance.
   2. Place warning signs at the beginning of the wet line, and at points well in advance of the marking equipment for alerting approaching traffic from both directions. Place small flags or other similarly effective small objects near freshly applied markings at frequent intervals to reduce crossing by traffic.
   3. If paint does not dry within expected time, discontinue paint operations until cause of slow drying is determined and corrected.
   4. Skip Markings: Synchronize one or more paint "guns" to automatically begin and cut off paint flow; make length of intervals as indicated.
   5. Use hand application by pneumatic spray for application of paint in areas where a mobile paint applicator cannot be used.

H. Parking Lots: Apply parking space lines, entrance and exit arrows, painted curbs, and other markings indicated on drawings.
   1. Mark the International Handicapped Symbol at indicated parking spaces.
   2. Hand application by pneumatic spray is acceptable.

I. Symbols: Use a suitable template that will provide a pavement marking with true, sharp edges and ends, of the design and size indicated.

3.04 DRYING, PROTECTION, AND REPLACEMENT

A. Protect newly painted markings so that paint is not picked up by tires, smeared, or tracked.

B. Provide barricades, warning signs, and flags as necessary to prevent traffic crossing newly painted markings.

C. Allow paint to dry at least the minimum time specified by the applicable paint standard and not less than that recommended by the manufacturer.

D. Remove and replace markings that are applied at less than minimum material rates; deviate from true alignment; exceed length and width tolerances; or show light spots, smears, or other deficiencies or irregularities.

E. Remove markings in manner to avoid damage to the surface to which the marking was applied, using carefully controlled sand blasting, approved grinding equipment, or other approved method.

F. Replace removed markings at no additional cost to Owner.

END OF SECTION

SECTION 32 3119 - DECORATIVE METAL FENCES AND GATES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Decorative aluminum fences and gates (Pedestrian).

1.02 RELATED REQUIREMENTS

A. Section 03 3000 - Cast-in-Place Concrete.

B. Section 32 3136 - Security Gates (Automatic Cantilevered Sliding Gates)

1.03 REFERENCE STANDARDS

A. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2014.

B. ASTM D2794 - Test Method for Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact) ; 1993 (Reapproved 2010).

C. ASTM D3359 - Standard Test Method for Measuring Adhesion by Tape Test; 2009.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Conduct a preinstallation meeting one week prior to start of work of this section; require attendance by affected installers.

1.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Submit manufacturer's data sheets on each product to be used, including:
   1. Preparation instructions and recommendations.
   2. Storage and handling requirements and recommendations.
   3. Installation methods.

C. Shop Drawings:
   1. Indicate plan layout, spacing of components, post foundation dimensions, hardware anchorage, gates, and schedule of components.

D. Manufacturer's Installation Instructions: Indicate installation requirements, post foundation anchor bolt templates, and al other associated parts..

E. Manufacturer's Warranty.

1.06 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with minimum five years documented experience.

B. Installer Qualifications: Experienced with type of construction involved and materials and techniques specified and approved by fence manufacturer.

1.07 DELIVERY, STORAGE AND HANDLING

A. Store materials in a manner to ensure proper ventilation and drainage. Protect against damage, weather, vandalism and theft.

1.08 WARRANTY

A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.

B. Correct defective Work within a five year period after Date of Substantial Completion.

C. Provide five year manufacturer warranty for all manufactured parts provided..

D. Finish: 10 years.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Decorative Metal Fences and Gates:
1. Alumi-Guard: www.alumi-guard.com/sle.
2. Ameristar Perimeter Security, USA; Echelon II, Magestic : www.ameristarfence.com. (BASIS OF DESIGN)
3. Superior Aluminum Products, Inc; _____: www.superioraluminum.com/#sle.
4. Substitutions: See Section 01 6000 - Product Requirements.

2.02 FENCES

A. Fences: Complete factory-fabricated system of posts and panels, accessories, fittings, and fasteners; finished with electrodeposition coating, and having the following performance characteristics:

B. Electro-Deposition Coating: Multi-stage pretreatment/wash with zinc phosphate, followed by epoxy primer and acrylic topcoat.
1. Total Coating Thickness: 2 mils, minimum.
2. Color: As selected by Architect from manufacturer's standard range.
3. Coating Performance: Comply with general requirements of ASTM F2408.
   a. Adhesion: ASTM D3359 (Method B); Class 3B with 90 percent or more of coating remaining in tested area.
   b. Impact Resistance: ASTM D2794; 60 inch pounds.

C. Aluminum: ASTM B221.
1. Tubular Pickets, Rails and Posts: 6005-T5 alloy.
2. Extrusions for Posts and Rails (Outer Channel): 6005-T5 alloy.
3. Extrusions for Pickets and Rail (Inner Slide Channels): 6063-T5 alloy.

D. Fasteners: ASTM A276/A276M, Type 302 stainless steel; finished to match fence components.

2.03 ALUMINUM FENCE

A. Decorative Aluminum Fence System: Provide fence meeting the Test Load and Coating Performance requirements of ASTM F2408 for Industrial class.
   1. Fence Panels: 6 feet high by 8 feet long.
      a. Panel Style: Two rail.
      b. Panel Strength: Capable of supporting 270 pounds minimum load applied at midspan without deflection.
      c. Attach panels to posts with manufacturer's standard panel brackets and recommended fasteners.
   2. Posts: Aluminum extrusions; 2-1/2 inches square.
   3. Rails: Extruded aluminum channels.
      a. Double-walled aluminum U channel; outside cross-section dimensions of 1-3/4 inch square; interior guide channel forms lower limit of raceway for retaining rod.
      b. Enclosed Retaining Rod: 1/8 inch diameter galvanized steel with variable pitch connection system for high angle racking and elimination of external fasteners.
      c. Picket-to-Rail Intersection Seals: PVC grommets.
      d. Picket Spacing, Standard: 4.715 inch on center.
   4. Pickets: Extruded aluminum tubes.
      a. Size: 1-1/4 inch square.
      b. Style: Flush top rail.
   5. Fasteners: Manufacturer's standard stainless steel bolts, screws, and washers; factory finish fasteners to match fence.
   6. Accessories: Aluminum castings, extrusions and cold-formed strips; factory finished to match fence.
      a. Flat post cap.
   7. Products:
      a. Ameristar Perimeter Security, USA; Echelon II: www.ameristarfence.com. (BASIS OF DESIGN)
      b. Substitutions: See Section 01 6000 - Product Requirements.

B. Decorative Aluminum Swing Gates:
   1. Gate Panels: Manufacturer's standard decorative aluminum fence panels.
   2. Posts: Aluminum extrusions; 2 inches square.
   3. Rails and Frame: Welded aluminum extrusions; 2 inches by 3 inches.
   4. Hardware:
      a. Latch: Manufacturer's standard mechanism; factory finished galvanized steel.
   5. Operation: Manual.
   6. Color: As selected by Architect from manufacturer's standard range.
   7. Size: See drawings for size of wing gates.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Set fence posts in accordance with the manufacturer recommended spacing.

3.02 TOLERANCES

A. Maximum Variation From Plumb: 1/4 inch.

B. Maximum Offset From Indicated Position: 1 inch.

C. Minimum Distance from Property Line: 6 inches.

3.03 CLEANING

A. Clean jobsite of excess materials; scatter excess material from post hole excavations uniformly away from posts. Remove excess material if required.

B. Clean fence with mild household detergent and clean water rinse well.

3.04 PROTECTION

A. Protect installed products until completion of project.

END OF SECTION

SECTION 32 3136 - SECURITY GATES AND BARRIERS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Security gates and barriers.

B. Controls and related wiring.

1.02 RELATED REQUIREMENTS

A. Section 26 0533 - Raceway and Boxes for Electrical Systems

B. Section 31 200 - Earth Moving

C. Section 32 1216 - Asphalt Paving: Installation of adjacent paved surfaces.

D. Section 32 1313 - Concrete Paving: Installation of adjacent paved surfaces.

1.03 REFERENCE STANDARDS

A. ASTM F2200 - Standard Specification for Automated Vehicular Gate Construction; 2014.

B. UL 325 - Standard for Door, Drapery, Gate, Louver, and Window Operators and Systems; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination: Coordinate installation of units with size, location and installation of service utilities.

B. Preinstallation Meeting: Conduct a preinstallation meeting one week prior to the start of work of this section; require attendance by affected installers.

C. Sequencing: Ensure that utility connections are completed in an orderly and expeditious manner.

1.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Shop Drawings: Provide detailed drawings showing:
   1. Layout and overall dimensions of each major element of the barrier equipment, including the hydraulic power unit and operator control panels, if applicable.
   2. Foundation and anchoring requirements of the barrier equipment.
   3. Hydraulic schematic drawing showing size and number of hoses required to run between the barrier device and the hydraulic power unit.
   4. Electrical schematic including associated wiring, showing electrically connected components, including interface points for connection to equipment; indicate minimum

conduit size and number of wires required to run between each component of the barrier equipment.

5. Schematic drawings of the entire barrier system, with manufacturer supplied equipment connected and integrated.

C. Certificate: Certify that products of this section meet or exceed specified requirements.

D. Test Reports: Indicate test data and results of field tests, including the demonstration and compliance with the specified performance criteria and final position of component adjustments and set points.

E. Operation and Maintenance Data.

F. Specimen Warranty.

G. Project Record Documents: After completion of field tests, provide updated drawings, showing exactly where equipment and controls are installed.

H. Software: Copy of software required for operation of products specified under this section.

I. Maintenance Materials: Furnish the following for Owner's use in project maintenance.
   1. See Section 01 6000 - Product Requirements, for additional provisions.
   2. Extra Stock Materials: Two of each kind of lubricant.
   3. Extra Stock Materials: Two of each kind of fuse.

1.06 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than five years of documented experience.

B. Installer's Qualifications: Company specializing in performing the work of this section with minimum 5 years of experience.

1.07 DELIVERY, STORAGE AND HANDLING

A. Store materials in a manner to ensure proper ventilation and drainage. Protect against damage, weather, vandalism and theft.

1.08 WARRANTY

A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.

B. Correct defective Work within a one year period after Date of Substantial Completion.

C. Provide Five year manufacturer warranty for materials and workmanship.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Security Gates and Barriers:

1. TYMETAL - FORTRESS STRUCTURAL CANTILEVER SLIDE GATE - ORNAMENTAL (BASIS OF DESIGN - 6'-0" high Gate)
2. Ameristar Perimeter Security, USA; _____: www.ameristarsecurity.com/#sle.
3. SecureUSA, Inc; ____: www.secureusa.net/#sle.
4. Substitutions: See Section 01 6000 - Product Requirements.

2.02 AUTOMATED GATES AND BARRIERS

A. Automated Gates and Barriers - General: Having following characteristics as well as characteristics specified for each type:
1. Comply with UL 325, Class I and ASTM F2200.
2. Operation: Automatic sliding cantilevered..
3. Material: Extruded Aluminum powder coated.Color TBD from manufacturers full range of colors..
4. Position Sensor: Barrier deployed (up).
5. Control Type: Touch Screen at remote location, Radio Transmitter reciever and card access controller options to be provided..
6. Detection Systems: Wrong-way.
7. Programming: Human Machine Interface Programmable Logic Controller (HMI PLC).
8. Weight Limitations on Retractable Barriers: 15,000 pounds.
9. Speed Limitations on Retractable Barriers: 15 mph.
10. Remote Operator Control Panel.
11. Emergency Fast Operate (EFO).
12. Traffic Signal Light. (only at gate exiting into US Highway 491)
13. Dual Channel Vehicle Module.
14. Battery Back-up.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verification of Conditions:
1. Verify location of existing utilities, grades and conditions of substrate.
2. Verify integration requirements with other site security equipment including but not limited to card readers, tire puncture devices, gates and other automated barrier systems.

3.02 PREPARATION

A. Protect existing work from damage due to installation of this work.

3.03 INSTALLATION

A. Install in accordance with manufacturer's instructions.

3.04 FIELD QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements, for additional requirements.

B. Provide manufacturer's certified, field supervisor during key milestones of the installation of the barrier.

3.05 SYSTEM STARTUP

A. Provide manufacturer's field representative to observe systems startup.

B. Prepare and start equipment in accordance with manufacturers' instructions and recommendations.

C. Adjust for proper operation within manufacturer's published tolerances.

3.06 CLEANING

A. Touch up scratched surfaces using materials recommended by manufacturer. Match touched-up paint color to factory-applied finish.

3.07 CLOSEOUT ACTIVITIES

A. See Section 01 7900 - Demonstration and Training, for additional requirements.

B. Demonstrate proper operation of equipment to Owner's designated representative.

C. Demonstration: Demonstrate operation of the barrier to Owner's personnel.
1. Use operation and maintenance data as reference during demonstration.
2. Briefly describe function, operation, and maintenance of each component.

D. Training: Train Owner's personnel on operation and maintenance of the barrier.
1. Use operation and maintenance manual as training reference, supplemented with additional training materials as required.
2. Provide minimum of two hours of training.
3. Location: At project site.

3.08 PROTECTION

A. Protect installed units from subsequent construction operations.

B. Do not permit traffic over unprotected barrier device.

3.09 MAINTENANCE

A. See Section 01 7000 - Execution and Closeout Requirements, for additional requirements relating to maintenance service.

B. Provide a separate maintenance contract for the service and maintenance for two years from Date of Substantial Completion.

END OF SECTION

SECTION 328400 – PLANTING IRRIGATION

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. Furnish all work and material, appliances, tools, equipment, facilities, transportation, and services necessary for and incidental to performing all operations in connection with the installation of underground sprinkler system complete, as shown on drawings and/or specified herein. When the term "Contractor" is used in this section, it shall refer to the irrigation contractor.

1.3 Applicable Standards

A. ASTM D2241 - Poly (Vinyl Chloride)(PVC) Plastic Pipe (SDR-PR)
B. D2464 - Poly (Vinyl Chloride)(PVC) Plastic Pipe Fittings, Threaded, Schedule 40
C. D2564 - Solvent cements for Poly (Vinyl Chloride)(PVC) Plastic Pipe and Fittings
D. D2855 - Making Solvent - Cemented Joints with Poly (Vinyl Chloride)(PVC) Pipe and Fittings
E. F-477 - Gasket Pocket Pipe

1.4 WARRANTEE AND MAINTENANCE

A. Warrantee:
1. The Contractor is required to guarantee the sprinkler irrigation system in accordance with the form below. A copy of the guarantee form shall be included in the Operations and Maintenance Manual. The guarantee form shall be on the Contractor's letterhead and contain the following information:

GUARANTEE FOR SPRINKLER IRRIGATION SYSTEM

We hereby guarantee that the sprinkler irrigation system we provided to be free from defects in materials and workmanship, and the work has been completed in accordance with the drawings and specifications, ordinary wear and tear, and unusual abuse or neglect excepted. We agree to repair or replace any defects in material or workmanship including repair of backfill settlement which may develop during the period of one year from the date of Substantial Completion and to repair or replace any damage related to such defects at no additional cost to the Owner. We shall make such repairs or replacements within a reasonable time, as determined by the Owner, after receipt of written notice from the Owner, we authorize the Owner to proceed to have said repairs or replacements made at our expense and we will pay the costs and charges therefore upon demand.

Project: _____

Location:_____

_____

Signed: _____ (Contractor)

Address: _____

Phone:_____

Date of Acceptance: _____

A. Maintenance
   1. Work shall include but not be limited to:
      a. Adjustment of sprinkler height and plumb to compensate for settlement and/or plant growth.
      b. Backfilling of all trenches.
      c. Adjustment of head coverage (arc of spray) as necessary.
      d. Unstopping heads plugged by foreign material.
      e. Adjustment of controller as necessary to insure proper sequence and watering time.
      f. All maintenance necessary to keep the system in good operating condition.
   2. Exclusions
      a. Guarantee and maintenance after final acceptance does not include alterations as necessitated by re-landscaping, regrading, addition of trees or the addition and/or changes in sidewalks, walls, driveways, etc., except to the extent that such work is caused or necessitated by the irrigation Contractor or his general Contractor.

1.5 SUBMITTALS

A. The Contractor shall submit to the Owner's Representative two (2) copies of shop drawings or manufacturer's "cut sheet" for each type of sprinkler head, pipe, controller, valves, check valve assemblies, valve boxes, wire, conduit, fittings and all other types of fixtures and equipment which he proposes to install on the job. The submittal shall include the manufacturer's name, model number, equipment capacity and manufacturer's installation recommendation, if applicable, for each proposed item.

B. A contract will not be issued to the Contractor until he has submitted the required information. No partial submittal will be accepted and submittals shall be neatly bound into a brochure and logically organized. After the submittal has been approved, substitutions will not be allowed except by written consent of the Owner's Representative.

C. Shop drawings
   1. Include dimensions, elevations, construction details, arrangements and capacity of equipment, as well as manufacturer's installation recommendations.

D. Record Drawings
   1. Record dimensioned locations and depths for each of the following:
      a. Sprinkler pressure line routing (Provide dimensions for each 100 lineal feet (maximum) alone each routing, and for each change in directions).
      b. Gate Valves, Irrigation control valves, Control wire routing, Sleeves under paving and other related items as may be directed by the Owner's Representative.

E. Dimensioning
   1. Locate all dimensions from two permanent points (buildings, monuments, sidewalks, curbs or pavements).

F. Changes

   1. Record all changes which are made from the Contract Drawings, including changes in the pressure and non-pressure lines.
   2. Record all required information on a set of blackline prints of the drawings. Do not use these prints for any other purpose.
   3. Maintain information daily. Keep drawings at the site at all times and available for review by the Owner's Representative.

F. Record Drawing Submittal
   1. When record drawings have been approved by the Owner's Representative, transfer all information to a set of reproducible mylars using permanent india ink.
   2. Changes using ball point pen are not acceptable.

3. Make dimensions accurately at the same scale used on the original drawings, or larger.
4. If photo reduction is required to facilitate controller chart housing, notes or dimensions shall be a minimum 1/4" in size.
5. Reproducible mylars will be furnished by the Owner's Representative at cost for printing and handling.

1.6 CONTROLLER CHARTS

A. Do not prepare charts until record drawings have been approved by the Owner's Representative.
B. Provide one controller chart for each automatic controller installed. Chart may be a reproduction of the Record Drawing, if the scale permits the chart to fit into the controller door. If photo reduction prints are required, keep reduction to maximum size possible to retain full legibility.
C. Chart shall be blackline print of the actual system showing the area covered by that controller. Identify the area of coverage of each remote control valve, using a distinct different pastel color drawn over the entire area of coverage.
D. Following approval of charts by the Owner's Representative, they shall be sealed between two layers of 20 mil plastic sheets.
E. Charts must be completed and approved prior to final acceptance of the irrigation system.

1.7 OPERATING AND MAINTENANCE MANUAL

A. Provide two individually bound manuals detailing operating and maintenance requirements for the irrigation system.
B. Manuals shall be delivered to the Owner's Representative no later than 10 days prior to completion of work.
C. Provide descriptions of all installed materials and systems in sufficient detail to permit maintenance personnel to understand, operate and maintain the equipment.
D. Information Required
   1. Index sheet, stating the Irrigation Contractor's name, address, telephone number and name of person to contact, Duration of guarantee period, Equipment list providing the following for each item:

      a. Manufacturer's name
      b. Make and model number
      c. Name and address of local manufacturer's representative
      d. Spare parts list in detail
      e. Detailed operating and maintenance instructions for major equipment.

1.8 SUBSTITUTION OF MATERIALS

A. This irrigation system has been designed around the irrigation components herein stated and as shown on the plans. Any changes of brand name, trade name, trademarked, patented articles, or any other substitutions will be allowed only by written order sighed by the Owner's Representative. The Owner is under no obligation to accept materials other than as specified. If a bidder wishes for a substitute item to receive consideration as an approved equal, the bidder and each item must meet all the following requirements without exceptions.

   1. Criteria
      a. An item, to be considered a substitute, must meet the same specifications of materials, fabrication or construction, dimension or size, shape, finish, performance standards, warranty or guarantee, and any other pertinent and salient features of quality, as indicated in manufacturer's specifications for the original specified item.
   2. Submittal for Consideration
      a. A sample of the item, along with a written request for consideration, shop drawings, and written specifications, must have been received by the Owner's Representative a minimum of ten (10) calendar days after bid opening date. The item shall

then be examined, and the bidder shall be notified, in writing, seven (7) days later, whether or not the item is an approved equal. The Owner's Representative shall be the final judge of whether or not an item submitted for consideration qualifies as being an acceptable substitute.

b. Under no circumstances shall an item be given consideration as an "approved equal" substitute later than ten (10) days after the bid opening. After that date, all items shall be bid per the original specifications. Likewise, unless certified as "approved equal" per the time frame and the requirements above, the successful bidder (known as Contractor after signing the contract) shall install all items per the original plans and specifications. Equipment or material installed or furnished without prior approval of the Owner's Representative as herein specified, may be rejected and the Contractor required to remove such materials at his own expense.

c. The Contractor alone shall bear complete responsibility for the installation and operation of any material or equipment installed on the job (as a substitute for specified equipment or material) should such substituted material prove to be defective, inoperable or inapplicable.

3. Codes and Permits

a. All work under this contract shall comply with the provisions of these specifications, as illustrated on the accompanying drawings, or as directed by the Owner's Representative and shall satisfy all applicable local codes, ordinances, or regulations of the governing bodies and all authorities having jurisdiction over this project.

b. Installation of equipment and material shall be done in accordance with the requirements of the National Electric Code, local and national Plumbing Codes and standard plumbing procedures. The drawings and these specifications are intended to comply with the necessary rules and regulations; however, some discrepancies may occur. Where such discrepancies occur, the contractor shall immediately notify the Owners Representative in writing of the discrepancies and apply for an interpretation. Should the discovery and notification occur after the execution of a contract, any additional work required for compliance with the regulations shall be paid for as covered by these contract documents.

c. The Contractor shall give all necessary notices, obtain all permits and pay all costs in connection with his work; file with all governmental departments having jurisdiction; obtain all required certificates of inspection for his work and deliver to the Owner's Representative before request for acceptance and final payment for his work.

d. The Contractor shall include in the work any labor, materials, services, apparatus or drawings in order to comply with all applicable laws, ordinances, rules and regulations whether or not shown on the drawings and/or specified.

1.9 QUALITY ASSURANCE

A. The installation of the irrigation system shall be made by an individual or firm duly licensed under the State of Arizona Registrar of Contractors.

1. Superintendent: A superintendent satisfactory to the Owner's Representative shall be on in the employ of the Contractor and shall be on the site at all times while the specified herein is being performed.
2. The superintendent shall not be changed, except with the consent of the Owner's Representative
3. The superintendent shall be authorized to represent the Contractor.
4. The superintendent shall have a minimum of 7 years irrigation installation experience and a minimum of 2 years supervisory experience.

1.10 NOTIFICATION OF OWNER'S REPRESENTATIVE

A. The Owner's Representative shall have free access to the work whenever it is in preparation or progress and proper facilities for such access and inspection. The Contractor shall notify the

Owner's Representative when he will and will not be on the job. Should the Contractor work periodically on the job, the Owner's Representative shall have the right to require the Contractor to give a 24 hour notice of each and every day or partial day that he intends to work on the project. The Contractor shall perform no work unless the Owner's Representative has been properly notified. Failure to notify the Owner's Representative may require the Contractor to redo, uncover pipe, expose for inspection, etc., all that the Owner's Representative was unable to inspect.

1.11 EXISTING UTILITIES

A. Location and Elevations: The Contractor shall examine the site and verify to his own satisfaction the locations and elevations of all utilities both public and private and availability of utilities and services required. The Contractor shall inform himself as to their relation to the work and the submission of bids shall be deemed as evidence thereof. The Contractor shall repair at his own expense, and to the satisfaction of the Owner's Representative, for damage to any utility shown or not shown on the plans.

B. Should utilities not shown on the plans be found during excavations Contractor shall promptly notify Owner's Representative for instructions as to further action.

C. Contractor shall make necessary adjustments in the layout as may be required to connect to existing stubouts, should any such stubouts not be located exactly as shown and as may be required to work around existing work, at no increase in cost to the Owner. All such work will be recorded on record drawings and turned over to the Owner's Representative prior to final acceptance.

1.12 COOPERATION

A. Work under this contract may be accomplished with other Contractors and trades on the project site at the same time. The Contractor shall allow each Contractor and trade adequate time at the proper stage of construction to fulfill his contract

1.13 ELECTRIC POWER

A. Electric power to operate the controller is existing at the controller locations except as noted on the Construction Drawings. Service wiring to the controller cabinet shall be furnished by the irrigation contractor.

1.14 WATER FOR TESTING

A. The Owner shall furnish all water necessary for testing, flushing and jetting.

1.15 EXTRA EQUIPMENT

A. Supply as part of this contract the following tools:
   1. Two sets of special tools required for removing, disassembling and adjusting each type of sprinkler and valve supplied on this project.
   2. Two keys for the automatic controller
   3. Three valve box keys or wrenches.
   4. The above mentioned equipment shall be turned over to the Owners Representative at the conclusion of the project. Before final inspection can occur, evidence that the Owner has received this material must be shown to the Owner's Representative.

1.16 SLEEVES AND ELECTRICAL CONDUITS

A. Sleeves and electrical conduits will need to be installed as noted on the Construction Drawings. Contractor shall be responsible for timely placement of all sleeves and conduits at no additional cost to the Owner.

1.17 PROGRESS MEETINGS

A. Contractor shall attend all progress meetings as requested by the Owner's Representative during installation and as needed to keep work progressing.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

A. Unless otherwise noted on the plans, all materials shall be new and unused. This irrigation system has been designed around the irrigation components herein stated and as shown on the plan. Any changes of brand name, trade name, trademarked, patented articles, or any other substitutions will be allowed only by written order as outlined in Section 1.06.

2.2 EQUIPMENT

A. PVC Pressure Mainline Pipe Fittings
   1. Pressure mainline piping shall be PVC Schedule 40.
   2. Pipe shall be made from NSF approved type I, grade I PVC compound conforming to ASTM specification D - 2241. Piping up to and including 3" size shall be SDR solvent weld. Pressure mainline piping 4" size and larger to be gasket pocket type as manufactured by the Swanson Company or equal, and shall conform to ASTM F-477.
   3. PVC solvent weld fittings shall be Schedule 80k, Type I NSF approved conforming to ASTM test procedure D2466 (for sizes up to and including 3") and shall be as manufactured by Spears, Lasco or Dura.
   4. Solvent cement and primer for PVC solvent-weld pipe and fittings shall be Red Hot Blue Glue and Christy's Purple Primer. Manufacturer's installation requirements shall be strictly adhered to.
   5. All PVC pipe shall bear the markings showing the Manufacturer's name, Nominal pipe size, Schedule or class, Pressure rating in psi, National Sanitation Foundation (NSF) approval and Date of extrusion.
   6. All fittings shall bear the manufacturer's name or trademark, material designation, size, applicable IPS schedule and NSF seal of approval.

B. PVC Non-Pressure Lateral Piping
   1. Non-pressure buried lateral line piping shall be PVC class 200 with solvent weld joints for sizes 3/4" and greater.
   2. Pipe shall be made from NSF approved, Type I, Grade II PVC compound conforming to ASTM resin specifications D1784. All pipe shall meet requirements set forth in Federal Specification PS-22-70, for the appropriate standard dimension ratio (SDR).
   3. PVC Solvent weld fittings shall be Schedule 40, Type I NSF approved conforming to ASTM test procedure D2466 as manufactured by Spears, Lasco or Dura.

C. Galvanized Pipe & Fittings
   1. Where indicated on the drawings and on the details, use galvanized steel pipe ASA Schedule 40 mild steel screwed pipe.
   2. Fittings shall be medium galvanized screwed beaded malleable iron. Galvanized couplings may be merchant coupling.
   3. All galvanized pipe and fittings installed below grade shall be painted with two coats of Koppers # 50 Bitumastic (except swing joint assembly).

D. Backflow Preventer
   1. Backflow Preventer shall be a reduced pressure type of the size shown on the project plans.

E. Gate Valves
   1. Brass ball valve similar to those manufactured by Champion.

F. Valve Boxes
   1. A box shall be provided for all valves and equipment as detailed on the project plans. Valve boxes shall be made of high-strength, plastic suitable for turf irrigation purposes. Boxes shall be suitable in size and configuration for the operability and adjustment of the valve. Extension sections will be used as appropriate to the depth of piping. All valve box covers shall bolt down and shall be colored Purple to indicate reclaimed water and imprinted "Irrigation".
   2. Boxes for valves shall have a locking or bolt down cover. Box shall be as manufactured by Ametek or approved equal. Only one remote control valve/gate valve assembly shall be installed per valve box. Box shall be rectangular in shape and be sufficiently large to allow easy access, maintenance and repair of the equipment contained therein.

G. Quick Coupling Valves and Wire Splices
   1. Box shall be a 10" diameter round, plastic valve box.

H. Electric Control Valves
   1. Valve shall be of size indicated on Drawings Valves shall be the Irritrol 700.

I. Control Wire
   1. Control wire shall be UF-UL listed, color coded copper conductor direct burial size 14. Tape control wires to side of main line every 10 feet. Where control wire leaves main or lateral line, bury a minimum of 24" deep. Use 3M DBY waterproof wire connectors at splices and locate all splices within valve boxes. Use white or gray color for common wire and other colors for all other wire. Each common wire may serve only one controller. Do not use black on any 24V circuit. One extra control wire shall be run from panel continuously from valve to valve throughout system controlled by that controller, similar to common wire for use if a wire fails. Wire shall be different color than all other wires, shall not be green, and shall be marked in control box as an extra wire.

J. Irrigation Controller
   1. Electric and Battery Automatic Controllers shall be: Rainbird ESP-LXME 12

K. Pressure Regulator
   1. Self contained, single seat, direct acting, spring loaded, diaphragm actuated type. The valve body shall be of all brass construction, stainless steel body seat, composition seat discs, BUNA-N diaphragm with nylon insert and stainless steel springs. The valve shall have a maximum working pressure rating of 150 psi and shall be capable of regulating outlet pressure from 5 to 30 psi and have an adjustment for setting the pressure. The downstream pressure variance shall not exceed a rate of 0.454 psi for every 10 psi variance in upstream or source pressure. The valve shall have an integral "Shrader" pressure test valve.

L. Filters
   1. Filters used down stream of the Remote Control Valves shall be a Y strainer type with minimum of 200 mesh filtration. The filter shall have a threaded opening to allow attachment of a hose for flushing. The filter shall have features similar to the Rainbird RBY-100-150MX.

M. Moisture Sensor
   1. The moisture sensor be wired to valve solenoid. The moisture Sensor shall have features similar to the Rainbird SMRT-Y.

O. Emitter Assembly
   1. Emitters shall be of the pressure compensating, self-flushing type.
   2. The cases of the emitters shall be made of durable black, heat resistant acetal plastic material. It shall be resistant to temperature variation, ultraviolet radiation, smog (ozone), common liquid fertilizer and weed spray.
   3. The emitter shall be capable of continuous, clog free operation with 140 mesh (minimum) filtration. The emitter shall be capable of being installed in any position and maintain its given flow characteristics. The emitter shall be non adjustable.
   4. The emitter shall function with a system pressure range of 15 psi minimum to 50 psi maximum. The emitters shall be available in flow ranges from .85 to 2.0 gph.

5. The emitter assemblies as shown on the plans shall consist of the emitter and .22" OD spaghetti distribution tubing which shall not exceed 8" in length.
6. Trees shall be irrigated with multi-port 1 or 2 gph/port, six ports per tree pending of species. Refer to Emitter schedule for required gallons per minute (see plans).

P. Emitter Hose
1. The flexible emitter hose, which shall deliver water to the emitter assembly shall be manufactured from virgin polyethylene material having the following physical characteristics:

O.D.	.704"
I.D.	.600 min.
Wall	.0052"
Carbon Black	1.5 - 3.5
Density	.92 - .93
Melt/Environmental Stress/Crack Resistance	0/100/100

2. Fittings for use with the emitter hose shall be of the compression, internal barb type, constructed of virgin PVC or glass-filled polypropylene materials, and as detailed on the project plans.

Q. Sleeves
1. Provide where shown on the drawings and specified herein.
2. All mainlines, lateral line piping, emitter headers and lateral piping and all control wire shall be installed in a sleeve under all paving, walls and concrete surfaces.
3. All sleeving shall be SCH 40 PVC solvent weld pipe.
4. All joints shall be solvent welded.
5. All sleeves shall be installed as detailed on the project plans.
6. All sleeves shall extend a minimum of 18" beyond the edge of the item being sleeved.
7. Each sleeve shall be taped along its entire length with metallic locator tape manufactured for that purpose.
8. Sleeves shall have a minimum horizontal clearance of 12" from each other and other piping. Sleeves shall not be installed parallel and directly over another line. Sleeves shall have a minimum of 9 inches vertical clearance where they cross other lines.

R. Other equipment:
1. Other Components shall be as recommended by Manufacturer and subject to Architect's review and acceptance and as necessary to complete and make system operational.

PART 3 – EXECUTION

3.1 GENERAL

A. Contractor Responsibility: The Contractor shall not willfully install the irrigation system as shown on the drawings when it is obvious in the field that obstructions, grade differences or discrepancies in equipment usage, area dimensions or static water pressure exist that might not have been considered in the engineering. Such obstructions or differences shall be brought to the attention of the Owner's Representative. In the event this notification is not performed, the Contractor shall assume full responsibility for any revision necessary.

B. All material and equipment shall be delivered to the job site in unbroken reels, cartons or other packaging to demonstrate that such material is new and of a quality and grade in keeping with the intent of these specifications.

3.2 SITE CONDITIONS

A. All scaled dimensions are approximate. The Contractor shall check and verify all size dimensions and receive the Owner's Representative's approval prior to beginning work.

B. Contractor shall be responsible for layout of all equipment and piping in the irrigation system. This layout shall be in conformance with notations on the Construction Drawings.

C. Exercise extreme care in excavating and working near existing utilities. Contractor shall be responsible for damage to utilities which are caused by his operation or neglect. Contractor shall check existing utility drawings and contact Bluestake prior to any excavation.
D. Coordinate installation of irrigation materials, including pipe so there shall be no interference with utilities or other construction or difficulty in planting trees, shrubs and ground covers. Contractor shall coordinate with other trades to insure timely placing of necessary sleeves, wires and pipes under walks, curbs and paving.
E. Design Pressure: This irrigation system has been designed to operate with a minimum static inlet water pressure as shown on the drawings. The Contractor shall take a pressure reading prior to beginning construction. If the pressure reading is less than indicated, the Contractor shall notify the Owner's Representative.

3.3 PREPARATION

A. Prior to installation, the Contractor shall stake out all pressure supply lines, location of remote control valves, sprinkler heads, controllers, backflow preventers, gate valves, quick coupling valves and other irrigation equipment.
B. All layout shall be approved by the Owner's Representative prior to installation. Prior approval shall be obtained for valves, controllers, main line routing, quick coupling valves, backflow preventers, water meters and sprinkler locations.

3.4 WATER SUPPLY

A. Irrigation system shall be connected to the new water mainline at the approximate location shown on the drawings. Contractor is responsible for minor changes caused by actual site conditions and tap locations.

3.5 EXCAVATION AND BACKFILL

A. Trenching
    1. Dig trenches straight and support pipe continuously on bottom of trench. Lay pipe to an even grade. Trenching excavation shall follow the layout as approved by the Owner's Representative in the field. If the bottom of a pipe trench excavation is found to consist of rock, caliche, or any other material that, be reason of its hardness or sharpness, cannot be excavated to give a uniform bearing surface, said rock or other material shall be removed for at least three (3) inches below the specified trench depth and refilled to the specified trench depth with sand or other approved shading material.
B. Burial of Pipe
    1. Depth of Pipe shall be as shown on the construction details
C. Backfilling
    1. The trenches shall not be backfilled until all the required tests are performed. Trenches shall be carefully backfilled in 8" lifts with the excavated materials, less any stone or clods of earth larger than 1/2" in any dimension. Backfill shall be mechanically compacted in landscape areas to a dry density equal to adjacent undisturbed soil. Backfill shall conform to adjacent grades without dips, sunken areas, humps or other surface irregularities. Backfilling shall not be performed while trenches or backfill material is in a wet or muddy condition.
    2. A fine granular material backfill will be initially placed on all lines to a depth of 3" over the top of the pipe. No foreign matter or particles larger than 1/2" in any one dimension will be permitted in this backfill. Existing site soil that conforms to this gradation requirement may be used for this initial backfill.
    3. Flooding of trenches will be permitted only with approval of the Owner's Representative.
    4. If settlement occurs and subsequent adjustments in pipe, valves, sprinkler heads, lawn or planting, or other construction are necessary, the Contractor shall make all required adjustments without cost to the owner. Contractor shall also make repairs or replacements

to any item damaged by settlement of trenches or irrigation equipment, whether said item was part of the original scope of construction or not.

D. Trenching and backfill under paving
   1. Trenches located under areas where paving, asphaltic concrete or concrete will be installed shall be backfilled with sand for a depth of 3" below the bottom of the pipe (or sleeve) and 3" above the top of the pipe (or sleeve). and compacted to 90% compaction or the required subgrade compaction for that area (whichever is greater), using manual or mechanical tamping devices. All trenches shall be left flush with the adjoining grade. The Contractor shall set in place, cap, and pressure test all piping under paving prior to the paving work.
   2. Provide for a minimum cover of 18" between the top of the pipe and the bottom of the aggregate base for all pressure and non-pressure piping installed under asphaltic concrete paving.

E. Assemblies
   1. Routing of sprinkler irrigation lines as indicated on the drawings is diagrammatic. Install lines and various assemblies to conform with the details shown on drawings and in accordance with the manufacturer's recommendations.
   2. Install no multiple assemblies on plastic lines. Provide each assembly with its own outlet.
   3. Install all assemblies specified herein in accordance with respective detail. In absence of detail drawings or specifications pertaining to specific items required to complete work, perform such work in accordance with best standard practice with the prior approval of the Owner's Representative.
   4. PVC pipe and fittings shall be thoroughly cleaned of dirt, dust and moisture before installation. Installation and solvent-welding methods shall be recommended by the pipe and fitting manufacturer. Primer shall be used on all solvent weld joint. No solvent weld joint shall be submitted to water pressure until curing for 24 hours minimum.
   5. On PVC to metal connections, the Contractor shall work the metal connections first. Teflon paste shall be used on all threaded PVC to PVC joints, and on all threaded PVC to metal joints. Light wrench pressure is all that is required. Where threaded PVC connections are required, use threaded PVC adapters into which the pipe may be welded. Teflon tape shall not be accepted.
   6. Gasket pocket pipe and fittings shall be assembled in strict accordance with the manufacturer's recommendations. Only recommended lubricant will be permitted.

F. Concrete thrust blocks
   1. Installed at specific locations per manufacturer's recommendations and instructions. Thrust blocks shall be installed for main lines at all changes in direction, tees, and gate valves.

G. PVC Pipe Installation:
   1. Piping shall be snaked in the trench to allow for thermal expansion and contraction.
   2. After all curing of solvent weld joints and after having received the approval of the Owner's Representative, the mainline shall be filled. Extreme care will be taken to slowly fill the piping while releasing entrapped air at the ends of the main line.
   3. All lines shall have a minimum clearance of six inches from each other, and from lines of other trades. This clearance shall not supersede any clearance required by local, regional or national building, health or safety codes. Parallel lines shall not be installed directly over one another.
   4. Manufacturer's installation recommendations shall be strictly adjured to.

H. Flushing of System
   1. After all new sprinkler pipe lines and risers are in place and connected, all necessary diversion work has been completed, and prior to installation of sprinkler, heads, the control valves shall be opened and a full head of water used to flush out the system.
   2. Sprinkler shall be installed only after flushing of the system has been accomplished to the complete satisfaction of the Owner's Representative.

I. Temporary Repairs
   1. The Owner reserves the right to make temporary repairs as necessary to keep the sprinkler system equipment in operating condition. The exercise of this right by the Owner's Representative shall not relieve the Contractor of his responsibilities under the terms of the guarantee as herein specified.

J. Pressure Regulator
   1. Install in a valve box in conformance with the project details.

K. Emitter Assembly
   1. The emitter and distribution tubing shall be assembled using the manufacturer's recommended tools and accessories.
   2. The maximum length of the .22" distribution tubing shall be 8'. In the event the distance in the field exceeds the maximum length, the Contractor shall extend the poly tubing as required by adding a tee and shall add a hose end cap to this extension at the Contractor's expense.
   3. The Contractor shall assemble the emitter assembly in conformance with the applicable detail on the project plans. This detail will depend on whether the emitter is irrigating a tree in turf or other ground plane material.

L. Emitter Hose
   1. The emitter hose location, as shown on the plans, is diagrammatic. The Contractor shall layout this hose so as to conform to the maximum distance requirements as specified under the emitter assembly section of these specifications.
   2. The Contractor shall flush the emitter hose prior to and after installation of the emitter assemblies.

3.6 FIELD QUALITY CONTROL

A. Adjustment of the system
   1. The Contractor shall flush and adjust all sprinkler heads for optimum performance and to prevent, as much as possible, over spray into walks, roadways and buildings.
   2. If it is determined that adjustments in the irrigation equipment will provide proper and more adequate coverage, the Contractor shall make such adjustments prior to planting. Adjustments may also include changes in nozzle sizes and degrees of arc as required. Such changes shall be approved in advance by the Owner's Representative, at no cost to the Owner.
   3. Lowering raised sprinkler heads by the Contractor shall be accomplished within 10 days after notification by the Owner.
   4. All sprinkler heads shall be set perpendicular to finished grades unless otherwise designated on the plans. On slopes, heads shall be angled for optimum coverage and performance.
   5. Owner's Representative to approve all head locations and reserves the right to request the contractor to make minor adjustments to head placement or nozzle selection at no cost to the Owner.
   6. All parts of the irrigation system and associated equipment shall be adjusted to function properly and shall be turned over to the Owner in operating condition.

B. Testing of the Irrigation System
   1. The Contractor shall request the presence of the Owner's Representative at least 48 hours in advance of testing.
   2. Test all pressure lines under hydrostatic pressure of 150 lbs. per square inch and prove water tight.
   3. All piping under paved areas shall be tested under hydrostatic pressure of 150 lbs. per square inch and proved water tight prior to paving.
   4. All PVC lateral line pipe shall be tested at working line pressures with coupling exposed and swing joints and other outlets capped.
   5. Sustain pressure in the lines for not less than two hours. Pipe sections shall be center loaded and all coupling shall be exposed. Before testing, the line shall have been filled with water for at least four (4) hours and provisions made for thoroughly bleeding the line of air.
   6. All hydrostatic tests shall be made only in the presence of the Owner's Representative. No pipe shall be backfilled until it has been inspected, tested and approved in writing.
   7. Furnish necessary force pump and all other equipment necessary to perform test.

8. When the sprinkler irrigation system is completed, perform a coverage test in the presence of the Owner's Representative to determine if the water coverage for the planting areas is complete and adequate. Furnish all materials and perform all work required to correct any inadequacies of coverage due to deviations from plans or where the system has been willfully installed as indicated on the drawings when it is obviously inadequate without bringing this to the attention of the Owner's Representative. This test shall be accomplished before any planting or turf has been installed.
9. Upon completion of each phase of work, entire system shall be tested and adjusted to meet site requirements.

3.7 MAINTENANCE

A. The entire irrigation system shall be under full automatic operation for a period of seven days prior to planting.
B. The Owner's Representative reserves the right to waive or shorten this operation period.
C. Contractor shall provide job maintenance of the entire irrigation system and shall continue until job acceptance by the Owner. Maintain all system components and assure proper watering of all plants. Repair all leaks and replace any defective components. After all landscape and irrigation operations are complete and in conformance with the contract documents, the Owner shall grant provisional acceptance.
D. Following provisional acceptance, the Contractor shall provide job maintenance for 90 days consisting of all items covered under maintenance. Following the 90 day maintenance period, the Owner shall grant final job acceptance after verifying all work and system components are in conformance with the Contract Documents.

3.7 CLEANUP

A. Cleanup shall be made as each portion of work progresses. Refuse and excess dirt shall be removed from the site, all walks and paving shall be broomed or washed down, and any damage sustained to the work of others shall be repaired to the original conditions acceptable to the Owner's Representative.

3.8 FINAL OBSERVATION PRIOR TO ACCEPTANCE

A. The Contractor shall operate each system in its entirety for the Owner's Representative at the time of final observation. Any items deemed not acceptable shall be reworked to the complete satisfaction of the Owner's Representative.
B. The Contractor shall show evidence to the Owner's Representative that the owner has received all accessories, charts, record drawings, and equipment as required before final observation can occur.

3.10 OBSERVATION SCHEDULE

A. Contractor shall be responsible for notifying the Owner's Representative in advance for the following observations according to the time indicated:
   Pre-job conference - 7 days
   Pressure supply line installation and testing - 48 hours
   Automatic controller installation - 48 hours
   Control wire installation - 48 hours
   Lateral line and sprinkler installation - 48 hours
   Coverage test - 48 hours
   Final observation - 7 days
B. When the inspections have been conducted by other than the Owner's Representative, show evidence and by whom these inspections were made.
C. No observation shall commence without as-built drawings.

1. In the event the Contractor calls for an observation without as-built drawings, without completing previously noted corrections, or without preparing the system for observations, he shall be responsible for reimbursing the Owner's Representative at the hourly rate in effect at the time of the observation, portal to portal (plus transportation cost) for the inconvenience. No further inspections will be scheduled until this charge has been made. Delays in schedules caused by Contractor's non-payment of these charges shall not be grounds for extension of the construction schedule.

END OF SECTION 328400

SECTION 329113 - SOIL PREPARATION

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 planting soils specified by composition of the mixes.

B. Related Requirements:
   1. Section 311000 "Site Clearing" for topsoil stripping and stockpiling.
   2. Section 329200 "Turf and Grasses" for placing planting soil for turf and grasses.
   3. Section 329300 "Plants" for placing planting soil for plantings.

1.3 DEFINITIONS

A. AAPFCO: Association of American Plant Food Control Officials.

B. Backfill: The earth used to replace or the act of replacing earth in an excavation. This can be amended or unamended soil as indicated.

C. CEC: Cation exchange capacity.

D. Compost: The product resulting from the controlled biological decomposition of organic material that has been sanitized through the generation of heat and stabilized to the point that it is beneficial to plant growth.

E. Duff Layer: A surface layer of soil, typical of forested areas, that is composed of mostly decayed leaves, twigs, and detritus.

F. Imported Soil: Soil that is transported to Project site for use.

G. Layered Soil Assembly: A designed series of planting soils, layered on each other, that together produce an environment for plant growth.

H. Manufactured Soil: Soil produced by blending soils, sand, stabilized organic soil amendments, and other materials to produce planting soil.

I. NAPT: North American Proficiency Testing Program. An SSSA program to assist soil-, plant-, and water-testing laboratories through inter laboratory sample exchanges and statistical evaluation of analytical data.

J. Organic Matter: The total of organic materials in soil exclusive of undecayed plant and animal tissues, their partial decomposition products, and the soil biomass; also called "humus" or "soil organic matter."

K. Planting Soil: Existing, on-site soil; imported soil; or manufactured soil that has been modified as specified with soil amendments and perhaps fertilizers to produce a soil mixture best for plant growth.

L. RCRA Metals: Hazardous metals identified by the EPA under the Resource Conservation and Recovery Act.

M. SSSA: Soil Science Society of America.

N. Subgrade: Surface or elevation of subsoil remaining after excavation is complete, or the top surface of a fill or backfill before planting soil is placed.

O. Subsoil: Soil beneath the level of subgrade; soil beneath the topsoil layers of a naturally occurring soil profile, typified by less than 1 percent organic matter and few soil organisms.

P. Surface Soil: Soil that is present at the top layer of the existing soil profile. In undisturbed areas, surface soil is typically called "topsoil"; but in disturbed areas such as urban environments, the surface soil can be subsoil.

Q. USCC: U.S. Composting Council.

1.4 PREINSTALLATION MEETINGS

A. Pre-installation Conference: Conduct conference at project site.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include recommendations for application and use.
2. Include test data substantiating that products comply with requirements.
3. Include sieve analyses for aggregate materials.
4. Material Certificates: For each type of imported soil and soil amendment and fertilizer before delivery to the site, according to the following:

    a. Manufacturer's qualified testing agency's certified analysis of standard products.
    b. Analysis of fertilizers, by a qualified testing agency, made according to AAPFCO methods for testing and labeling and according to AAPFCO's SUIP #25.
    c. Analysis of nonstandard materials, by a qualified testing agency, made according to SSSA methods, where applicable.

B. Samples: For each bulk-supplied material, 1-quart volume of each in sealed containers labeled with content, source, and date obtained. Each Sample shall be typical of the lot of material to be furnished; provide an accurate representation of composition, color, and texture.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For each testing agency.

B. Preconstruction Test Reports: For preconstruction soil analyses specified in "Preconstruction Testing" Article.

C. Field quality-control reports.

1.7 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent, state-operated, or university-operated laboratory; experienced in soil science, soil testing, and plant nutrition; with the experience and capability to conduct the testing indicated; and that specializes in types of tests to be performed.

1. Multiple Laboratories: At Contractor's option, work may be divided among qualified testing laboratories specializing in physical testing, chemical testing, and fertility testing.

1.8 PRECONSTRUCTION TESTING

A. Preconstruction Testing Service: Engage a qualified testing agency to perform preconstruction soil analyses on existing, on-site soil and imported soil**.**

1. Notify Architect seven days in advance of the dates and times when laboratory samples will be taken.

B. Preconstruction Soil Analyses: For each unamended soil type, perform testing on soil samples and furnish soil analysis and a written report containing soil-amendment and fertilizer recommendations by a qualified testing agency performing the testing according to "Soil-Sampling Requirements" and "Testing Requirements" articles.

1. Have testing agency identify and label samples and test reports according to sample collection and labeling requirements.

1.9 SOIL-SAMPLING REQUIREMENTS

A. General: Extract soil samples according to requirements in this article.

B. Sample Collection and Labeling: Have samples taken and labeled by Contractor in presence of Architect under the direction of the testing agency.

1. Number and Location of Samples: Minimum of three representative soil samples from varied locations for each soil to be used or amended for landscaping purposes.
2. Procedures and Depth of Samples: According to USDA-NRCS's "Field Book for Describing and Sampling Soils."
3. Division of Samples: Split each sample into two, equal parts. Send half to the testing agency and half to Owner for its records.
4. Labeling: Label each sample with the date, location keyed to a site plan or other location system, visible soil condition, and sampling depth.

1.10 TESTING REQUIREMENTS

A. General: Perform tests on soil samples according to requirements in this article.

B. Physical Testing:

1. Soil Texture: Soil-particle, size-distribution analysis byone of the following methods according to SSSA's "Methods of Soil Analysis - Part 1-Physical and Mineralogical Methods":

    a. Sieving Method: Report sand-gradation percentages for very coarse, coarse, medium, fine, and very fine sand; and fragment-gradation (gravel) percentages for fine, medium, and coarse fragments; according to USDA sand and fragment sizes.
    b. Hydrometer Method: Report percentages of sand, silt, and clay.

2. Total Porosity: Calculate using particle density and bulk density according to SSSA's "Methods of Soil Analysis - Part 1-Physical and Mineralogical Methods."
3. Water Retention: According to SSSA's "Methods of Soil Analysis - Part 1-Physical and Mineralogical Methods."
4. Saturated Hydraulic Conductivity: According to SSSA's "Methods of Soil Analysis - Part 1-Physical and Mineralogical Methods"; at 85% compaction according to ASTM D 698 (Standard Proctor).

C. Chemical Testing:

1. CEC: Analysis by sodium saturation at pH 7 according to SSSA's "Methods of Soil Analysis - Part 3- Chemical Methods."
2. Clay Mineralogy: Analysis and estimated percentage of expandable clay minerals using CEC by ammonium saturation at pH 7 according to SSSA's "Methods of Soil Analysis - Part 1- Physical and Mineralogical Methods."
3. Metals Hazardous to Human Health: Test for presence and quantities of RCRA metals including aluminum, arsenic, barium, copper, cadmium, chromium, cobalt, lead, lithium, and vanadium. If RCRA metals are present, include recommendations for corrective action.
4. Phytotoxicity: Test for plant-available concentrations of phytotoxic minerals including aluminum, arsenic, barium, cadmium, chlorides, chromium, cobalt, copper, lead, lithium, mercury, nickel, selenium, silver, sodium, strontium, tin, titanium, vanadium, and zinc.

D. Fertility Testing: Soil-fertility analysis according to standard laboratory protocol of SSSA NAPT NCR-13 including the following:

1. Percentage of organic matter.
2. CEC, calcium percent of CEC, and magnesium percent of CEC.
3. Soil reaction (acidity/alkalinity pH value).
4. Buffered acidity or alkalinity.
5. Nitrogen ppm.
6. Phosphorous ppm.
7. Potassium ppm.
8. Manganese ppm.
9. Manganese-availability ppm.
10. Zinc ppm.
11. Zinc availability ppm.
12. Copper ppm.
13. Sodium ppm
14. Soluble-salts ppm.
15. Presence and quantities of problem materials including salts and metals cited in the Standard protocol. If such problem materials are present, provide additional recommendations for corrective action.
16. Other deleterious materials, including their characteristics and content of each.

E. Organic-Matter Content: Analysis using loss-by-ignition method according to SSSA's "Methods of Soil Analysis - Part 3- Chemical Methods."

F. Recommendations: Based on the test results, state recommendations for soil treatments and soil amendments to be incorporated to produce satisfactory planting soil suitable for healthy, viable plants indicated. Include, at a minimum, recommendations for nitrogen, phosphorous, and potassium fertilization, and for micronutrients.

1.11 DELIVERY, STORAGE, AND HANDLING

A. Packaged Materials: Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and compliance with state and Federal laws if applicable.

B. Bulk Materials:

1. Do not dump or store bulk materials near structures, utilities, walkways and pavements, or on existing turf areas or plants.
2. Provide erosion-control measures to prevent erosion or displacement of bulk materials, discharge of soil-bearing water runoff, and airborne dust reaching adjacent properties, water conveyance systems, or walkways.
3. Do not move or handle materials when they are wet or frozen.
4. Accompany each delivery of bulk fertilizers and soil amendments with appropriate certificates.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Regional Materials: Imported soil and soil amendments and fertilizers shall be manufactured within 500 miles of Project site from materials that have been extracted, harvested, or recovered, as well as manufactured, within 500 miles of Project site.

2.2 INORGANIC SOIL AMENDMENTS

A. Lime: ASTM C 602, agricultural liming material containing a minimum of 80 percent calcium carbonate equivalent and as follows:

1. Class: T, with a minimum of 99 percent passing through a No. 8 sieve and a minimum of 75 percent passing through a No. 60 sieve.
2. Class: O, with a minimum of 95 percent passing through a No. 8 sieve and a minimum of 55 percent passing through a No. 60 sieve.
3. Form: Provide lime in form of ground dolomitic limestone**.**

B. Sulfur: Granular, biodegradable, and containing a minimum of 90 percent elemental sulfur, with a minimum of 99 percent passing through a No. 6 sieve and a maximum of 10 percent passing through a No. 40 sieve.

C. Iron Sulfate: Granulated ferrous sulfate containing a minimum of 20 percent iron and 10 percent sulfur.

D. Perlite: Horticultural perlite, soil amendment grade.

E. Agricultural Gypsum: Minimum 90 percent calcium sulfate, finely ground with 90 percent passing through a No. 50 sieve.

F. Sand: Clean, washed, natural or manufactured, free of toxic materials, and according to ASTM C 33/C 33M.

2.3 ORGANIC SOIL AMENDMENTS

A. Compost: Well-composted, stable, and weed-free organic matter produced by composting feedstock, and bearing USCC's "Seal of Testing Assurance," and as follows:

1. Feedstock: May include animal waste
2. Reaction: pH of 5.5 to 8
3. Soluble-Salt Concentration: Less than 4 dS/m.
4. Moisture Content: 35 to 55 percent by weight.
5. Organic-Matter Content: 30 to 40 percent of dry weight.
6. Particle Size: Minimum of 98 percent passing through a 4-inch sieve.

B. Sphagnum Peat: Partially decomposed sphagnum peat moss, finely divided or of granular texture with 100 percent passing through a 1/2-inch sieve, a pH of 3.4 to 4.8, and a soluble-salt content measured by electrical conductivity of maximum 5 dS/m.

C. Muck Peat: Partially decomposed moss peat, native peat, or reed-sedge peat, finely divided or of granular texture with 100 percent passing through a 1/2-inch sieve, a pH of 6 to 7.5, a soluble-salt content measured by electrical conductivity of maximum 5 dS/m, having a water-absorbing capacity of 1100 to 2000 percent, and containing no sand.

D. Wood Derivatives: Shredded and composted, nitrogen-treated sawdust, ground bark, or wood waste; of uniform texture and free of chips, stones, sticks, soil, or toxic materials.

1. Partially Decomposed Wood Derivatives: In lieu of shredded and composted wood derivatives, mix shredded and partially decomposed wood derivatives with ammonium nitrate at a minimum rate of 0.15 lb/cu. ft.of loose sawdust or ground bark, or with ammonium sulfate at a minimum rate of 0.25 lb/cu. ft. of loose sawdust or ground bark.

E. Manure: Well-rotted, unleached, stable or cattle manure containing not more than 25 percent by volume of straw, sawdust, or other bedding materials; free of toxic substances, stones, sticks, soil, weed seed, debris, and material harmful to plant growth.

2.4 FERTILIZERS

A. Superphosphate: Commercial, phosphate mixture, soluble; a minimum of 20 percent available phosphoric acid.

B. Commercial Fertilizer: Commercial-grade complete fertilizer of neutral character, consisting of fast- and slow-release nitrogen, 50 percent derived from natural organic sources of urea formaldehyde, phosphorous, and potassium in the following composition:

1. Composition: 1 lb/1000 sq. ft. of actual nitrogen, 4 percent phosphorous, and 2 percent potassium, by weight.
2. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified testing agency.

C. Slow-Release Fertilizer: Granular or pelleted fertilizer consisting of 50 percent water-insoluble nitrogen, phosphorus, and potassium in the following composition:

1. Composition: 20 percent nitrogen, 10 percent phosphorous, and 10 percent potassium, by weight.
2. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified testing agency.

D. Chelated Iron: Commercial-grade FeEDDHA for dicots and woody plants, and commercial-grade FeDTPA for ornamental grasses and monocots.

PART 3 - EXECUTION

3.1 GENERAL

A. Place planting soil and fertilizers according to requirements in other Specification Sections.

B. Verify that no foreign or deleterious material or liquid such as paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, or acid has been deposited in planting soil.

C. Proceed with placement only after unsatisfactory conditions have been corrected.

3.2 PREPARATION OF UNAMENDED, ON-SITE SOIL BEFORE AMENDING

A. Excavation: Excavate soil from designated area(s) to a depth of 6 inches and stockpile until amended.

B. Unacceptable Materials: Clean soil of concrete slurry, concrete layers or chunks, cement, plaster, building debris, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, acid, and other extraneous materials that are harmful to plant growth.

C. Unsuitable Materials: Clean soil to contain a maximum of 8 percent by dry weight of stones, roots, plants, sod, clay lumps, and pockets of coarse sand.

D. Screening: Pass unamended soil through a 2-inch sieve to remove large materials.

3.3 PLACING AND MIXING PLANTING SOIL OVER EXPOSED SUBGRADE

A. General: Apply and mix unamended soil with amendments on-site to produce required planting soil. Do not apply materials or till if existing soil or subgrade is frozen, muddy, or excessively wet.

B. Subgrade Preparation: Till subgrade to a minimum depth of 18 inches. Remove stones larger than 1-1/2 inches in any dimension and sticks, roots, rubbish, and other extraneous matter and legally dispose of them off Owner's property.

1. Apply, add soil amendments, and mix approximately half the thickness of unamended soil over prepared, loosened subgrade according to "Mixing" Paragraph below. Mix thoroughly into top 2 inches of subgrade. Spread remainder of planting soil.

C. Mixing: Spread unamended soil to total depth of 12 inches but not less than required to meet finish grades after mixing with amendments and natural settlement. Do not spread if soil or subgrade is frozen, muddy, or excessively wet.

1. Amendments: Apply soil amendments, except compost, and fertilizer, if required, evenly on surface, and thoroughly blend them with unamended soil to produce planting soil.

a. Mix lime and sulfur with dry soil before mixing fertilizer.
b. Mix fertilizer with planting soil no more than seven days before planting.

2. Lifts: Apply and mix unamended soil and amendments in lifts not exceeding 12 inches in loose depth for material compacted by compaction equipment, and not more than 4 inches in loose depth for material compacted by hand-operated tampers.

D. Compaction: Compact each blended lift of planting soil to 75 to 82 percent of maximum Standard Proctor density according to ASTM D 698 and tested in-place except where a different compaction value is indicated on Drawings.

E. Finish Grading: Grade planting soil to a smooth, uniform surface plane with loose, uniformly fine texture. Roll and rake, remove ridges, and fill depressions to meet finish grades.

3.4 APPLYING COMPOST TO SURFACE OF PLANTING SOIL

A. Application: Apply compost component of planting-soil mix 4 inches of compost to surface of in-place planting soil. Do not apply materials or till if existing soil or subgrade is frozen, muddy, or excessively wet.

B. Finish Grading: Grade surface to a smooth, uniform surface plane with loose, uniformly fine texture. Roll and rake, remove ridges, and fill depressions to meet finish grades.

3.5 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Perform the following tests:

1. Compaction: Test planting-soil compaction after placing each lift and at completion using a densitometer or soil-compaction meter calibrated to a reference test value based on laboratory testing according to ASTM D 698. Space tests at no less than one for each 2000 sq. ft. of in-place soil or part thereof.

C. Soil will be considered defective if it does not pass tests.

D. Prepare test reports.

E. Label each sample and test report with the date, location keyed to a site plan or other location system, visible conditions when and where sample was taken, and sampling depth.

3.6 PROTECTION

A. Protection Zone: Identify protection zones according to Section 015639 "Temporary Tree and Plant Protection."

B. Protect areas of in-place soil from additional compaction, disturbance, and contamination. Prohibit the following practices within these areas except as required to perform planting operations:

1. Storage of construction materials, debris, or excavated material.
2. Parking vehicles or equipment.
3. Vehicle traffic.
4. Foot traffic.
5. Erection of sheds or structures.
6. Impoundment of water.
7. Excavation or other digging unless otherwise indicated.

C. If planting soil or subgrade is over compacted, disturbed, or contaminated by foreign or deleterious materials or liquids, remove the planting soil and contamination; restore the subgrade as directed by Architect and replace contaminated planting soil with new planting soil.

3.7 CLEANING

A. Protect areas adjacent to planting-soil preparation and placement areas from contamination. Keep adjacent paving and construction clean and work area in an orderly condition.

B. Remove surplus soil and waste material including excess subsoil, unsuitable materials, trash, and debris and legally dispose of them off Owner's property unless otherwise indicated.

1. Dispose of excess subsoil and unsuitable materials on-site where directed by Owner.

END OF SECTION 329113

SECTION 329300 - PLANTS

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. Plants.
2. Tree stabilization.
3. Tree-watering devices.
4. Landscape edgings.
5. Tree grates.
6. Muching.
7. Stabilized Decomposed Granite.

B. Related Requirements:

1. Section 015639 "Temporary Tree and Plant Protection" for protecting, trimming, pruning, repairing, and replacing existing trees to remain that interfere with, or are affected by, execution of the Work.
2. Section 329200 "Turf and Grasses" for turf (lawn) and meadow planting, hydroseeding, and erosion-control materials.

1.3 DEFINITIONS

A. Backfill: The earth used to replace or the act of replacing earth in an excavation.

B. Balled and Burlapped Stock: Plants dug with firm, natural balls of earth in which they were grown, with a ball size not less than diameter and depth recommended by ANSI Z60.1 for type and size of plant required; wrapped with burlap, tied, rigidly supported, and drum laced with twine with the root flare visible at the surface of the ball as recommended by ANSI Z60.1.

C. Balled and Potted Stock: Plants dug with firm, natural balls of earth in which they are grown and placed, unbroken, in a container. Ball size is not less than diameter and depth recommended by ANSI Z60.1 for type and size of plant required.

D. Bare-Root Stock: Plants with a well-branched, fibrous-root system developed by transplanting or root pruning, with soil or growing medium removed, and with not less than the minimum root spread according to ANSI Z60.1 for type and size of plant required.

E. Container-Grown Stock: Healthy, vigorous, well-rooted plants grown in a container, with a well-established root system reaching sides of container and maintaining a firm ball when removed from container. Container shall be rigid enough to hold ball shape and protect root mass during shipping and be sized according to ANSI Z60.1 for type and size of plant required.

F. Fabric Bag-Grown Stock: Healthy, vigorous, well-rooted plants established and grown in-ground in a porous fabric bag with well-established root system reaching sides of fabric bag. Fabric bag size is not less than diameter, depth, and volume required by ANSI Z60.1 for type and size of plant.

G. Finish Grade: Elevation of finished surface of planting soil.

H. Pesticide: A substance or mixture intended for preventing, destroying, repelling, or mitigating a pest. Pesticides include insecticides, miticides, herbicides, fungicides, rodenticides, and molluscicides. They also include substances or mixtures intended for use as a plant regulator, defoliant, or desiccant. Some sources classify herbicides separately from pesticides.

I. Pests: Living organisms that occur where they are not desired or that cause damage to plants, animals, or people. Pests include insects, mites, grubs, mollusks (snails and slugs), rodents (gophers, moles, and mice), unwanted plants (weeds), fungi, bacteria, and viruses.

J. Planting Area: Areas to be planted.

K. Planting Soil: Existing, on-site soil; imported soil; or manufactured soil that has been modified with soil amendments and perhaps fertilizers to produce a soil mixture best for plant growth. See Section 329113 "Soil Preparation"for drawing designations for planting soils.

L. Plant; Plants; Plant Material: These terms refer to vegetation in general, including trees, shrubs, vines, ground covers, ornamental grasses, bulbs, corms, tubers, or herbaceous vegetation.

M. Root Flare: Also called "trunk flare." The area at the base of the plant's stem or trunk where the stem or trunk broadens to form roots; the area of transition between the root system and the stem or trunk.

N. Stem Girdling Roots: Roots that encircle the stems (trunks) of trees below the soil surface.

O. Subgrade: The surface or elevation of subsoil remaining after excavation is complete, or the top surface of a fill or backfill before planting soil is placed.

1.4 COORDINATION

A. Coordination with Turf Areas (Lawns): Plant trees, shrubs, and other plants after finish grades are established and before planting turf areas unless otherwise indicated.

1. When planting trees, shrubs, and other plants after planting turf areas, protect turf areas, and promptly repair damage caused by planting operations.

B. Stabilized Decomposed Granite: Decomposed Granite ¼” screened aggregate paving with stabilizer additive.

1. Tests: Perform gradation of decomposed granite material in accordance with ASTM C 136 – Method for Sieve Analysis for Fine and Course.
2. Mock Ups: Install 4ft x 10ft wide mockup of decomposed granite paving with stabilizer additive at location as directed by Landscape Architect or Owner’s Representative.

1.5 PREINSTALLATION MEETINGS

A. Pre-installation Conference: Conduct conference at project site.

1.6 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Plant Materials: Include quantities, sizes, quality, and sources for plant materials.

B. Samples for Verification: For each of the following:

1. Trees and Shrubs: Three Samples of each variety and size delivered to site for review. Maintain approved Samples on-site as a standard for comparison.
2. Organic Mulch: 1-pint volume of each organic mulch required; in sealed plastic bags labeled with composition of materials by percentage of weight and source of mulch. Each Sample shall be typical of the lot of material to be furnished; provide an accurate representation of color, texture, and organic makeup.
3. Mineral Mulch: 5 lb of mineral mulch (Decomposed Granite ¾" Screened) required, in sealed plastic bags labeled with source of mulch. Sample shall be typical of the lot of material to be delivered and installed on-site; provide an accurate indication of color, texture, and makeup of the material.
4. Stabilized Decomposed Granite: 5lb sample and sieve analysis for grading of Decomposed Granite ¼" Screened Aggregate, required, in sealed plastic bags labeled with source of mulch. Sample shall be typical of the lot of material to be delivered and installed on-site; provide an accurate indication of color, texture, and makeup of the material.
5. Weed Control Barrier: 12 by 12 inches.
6. Proprietary Root-Ball-Stabilization Device: One unit.
7. Edging Materials and Accessories: Manufacturer's standard size, to verify color selected.
8. Root Barrier: Width of panel by 12 inches.

1.7 INFORMATIONAL SUBMITTALS

A. Qualification Data: For landscape Installer. Include list of similar projects completed by Installer demonstrating Installer's capabilities and experience. Include project names, addresses, and year completed, and include names and addresses of owners' contact persons.

B. Product Certificates: For each type of manufactured product, from manufacturer, and complying with the following:

1. Manufacturer's certified analysis of standard products.
2. Analysis of other materials by a recognized laboratory made according to methods established by the Association of Official Analytical Chemists, where applicable.

C. Pesticides and Herbicides: Product label and manufacturer's application instructions specific to Project.

D. Sample Warranty: For special warranty.

1.8 CLOSEOUT SUBMITTALS

A. Maintenance Data: Recommended procedures to be established by Owner for maintenance of plants during a calendar year. Submit before expiration of required maintenance periods.

1.9 QUALITY ASSURANCE

A. Installer Qualifications: A qualified landscape installer whose work has resulted in successful establishment of plants.

1. Professional Membership: Installer shall be a member in good standing of either the Professional Landcare Network or the American Nursery and Landscape Association.
2. Experience: Five years' experience in landscape installation in addition to requirements in Section 014000 "Quality Requirements."
3. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on Project site when work is in progress.
4. Personnel Certifications: Installer's field supervisor shall have certification in one of the following categories from the Professional Landcare Network:

    a. Landscape Industry Certified Technician - Exterior.
    b. Landscape Industry Certified Interior.
    c. Landscape Industry Certified Horticultural Technician.

5. Pesticide Applicator: State licensed, commercial.

B. Provide quality, size, genus, species, and variety of plants indicated, complying with applicable requirements in ANSI Z60.1.

1. Selection of plants purchased under allowances is made by Architect, who tags plants at their place of growth before they are prepared for transplanting.

C. Measurements: Measure according to ANSI Z60.1. Do not prune to obtain required sizes.

1. Trees and Shrubs: Measure with branches and trunks or canes in their normal position. Take height measurements from or near the top of the root flare for field-grown stock and container-grown stock. Measure main body of tree or shrub for height and spread; do not measure branches or roots tip to tip. Take caliper measurements 6 inches above the root flare for trees up to 4-inch caliper size, and 12 inches above the root flare for larger sizes.
2. Other Plants: Measure with stems, petioles, and foliage in their normal position.

D. Plant Material Observation: Landscape Architect may observe plant material either at place of growth or at site before planting for compliance with requirements for genus, species, variety, cultivar, size, and quality. Landscape Architect may also observe trees and shrubs further for size and condition of balls and root systems, pests, disease symptoms, injuries, and latent defects and may reject unsatisfactory or defective material at any time during progress of work. Remove rejected trees or shrubs immediately from Project site.

1. Notify Landscape Architect of sources of planting materials fourteen (14) days in advance of delivery to site.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Packaged Materials: Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and indication of compliance with state and Federal laws if applicable.

B. Bulk Materials:

1. Do not dump or store bulk materials near structures, utilities, walkways and pavements, or on existing turf areas or plants.
2. Provide erosion-control measures to prevent erosion or displacement of bulk materials; discharge of soil-bearing water runoff; and airborne dust reaching adjacent properties, water conveyance systems, or walkways.
3. Accompany each delivery of bulk materials with appropriate certificates.

C. Deliver bare-root stock plants within 24 hours of digging. Immediately after digging up bare-root stock, pack root system in wet straw, hay, or other suitable material to keep root system moist until planting. Transport in covered, temperature-controlled vehicles, and keep plants cool and protected from sun and wind at all times.

D. Do not prune trees and shrubs before delivery. Protect bark, branches, and root systems from sun scald, drying, wind burn, sweating, whipping, and other handling and tying damage. Do not bend or bind-tie trees or shrubs in such a manner as to destroy their natural shape. Provide protective covering of plants during shipping and delivery. Do not drop plants during delivery and handling.

E. Handle planting stock by root ball.

F. Store bulbs, corms, and tubers in a dry place at 60 to 65 deg F until planting.

G. Apply antidesiccant to trees and shrubs using power spray to provide an adequate film over trunks (before wrapping), branches, stems, twigs, and foliage to protect during digging, handling, and transportation.

1. If deciduous trees or shrubs are moved in full leaf, spray with antidesiccant at nursery before moving and again two weeks after planting.

H. Wrap trees and shrubs with burlap fabric over trunks, branches, stems, twigs, and foliage to protect from wind and other damage during digging, handling, and transportation.

I. Deliver plants after preparations for planting have been completed, and install immediately. If planting is delayed more than six hours after delivery, set plants and trees in their appropriate aspect (sun, filtered sun, or shade), protect from weather and mechanical damage, and keep roots moist.

1. Heel-in bare-root stock. Soak roots that are in less than moist condition in water for two hours. Reject plants with dry roots.
2. Set balled stock on ground and cover ball with soil, peat moss, sawdust, or other acceptable material.
3. Do not remove container-grown stock from containers before time of planting.
4. Water root systems of plants stored on-site deeply and thoroughly with a fine-mist spray. Water as often as necessary to maintain root systems in a moist, but not overly wet condition.

1.11 FIELD CONDITIONS

A. Field Measurements: Verify actual grade elevations, service and utility locations, irrigation system components, and dimensions of plantings and construction contiguous with new plantings by field measurements before proceeding with planting work.

B. Weather Limitations: Proceed with planting only when existing and forecasted weather conditions permit planting to be performed when beneficial and optimum results may be obtained. Apply products during favorable weather conditions according to manufacturer's written instructions and warranty requirements.

1.12 WARRANTY

A. Special Warranty: Installer agrees to repair or replace plantings and accessories that fail in materials, workmanship, or growth within specified warranty period.

1. Failures include, but are not limited to, the following:

   a. Death and unsatisfactory growth, except for defects resulting from abuse, lack of adequate maintenance, or neglect by Owner.
   b. Structural failures including plantings falling or blowing over.
   c. Faulty performance of tree stabilization and edgings**.**
   d. Deterioration of metals, metal finishes, and other materials beyond normal weathering.

2. Warranty Periods: From date of Substantial Completion.

   a. Trees, Shrubs, Vines, and Ornamental Grasses: 18 months.
   b. Ground Covers, Biennials, Perennials, and Other Plants: 18 months.
   c. Annuals: Six months.

3. Include the following remedial actions as a minimum:

   a. Immediately remove dead plants and replace unless required to plant in the succeeding planting season.
   b. Replace plants that are more than 25 percent dead or in an unhealthy condition at end of warranty period.
   c. A limit of one replacement of each plant is required except for losses or replacements due to failure to comply with requirements.
   d. Provide extended warranty for period equal to original warranty period, for replaced plant material.

PART 2 - PRODUCTS

2.1 PLANT MATERIAL

A. General: Furnish nursery-grown plants true to genus, species, variety, cultivar, stem form, shearing, and other features indicated in Plant List, Plant Schedule, or Plant Legend indicated on Drawings and complying with ANSI Z60.1; and with healthy root systems developed by transplanting or root pruning. Provide well-shaped, fully branched, healthy, vigorous stock, densely foliated when in leaf and free of disease, pests, eggs, larvae, and defects such as knots, sun scald, injuries, abrasions, and disfigurement.

1. Trees with damaged, crooked, or multiple leaders; tight vertical branches where bark is squeezed between two branches or between branch and trunk ("included bark"); crossing trunks; cut-off limbs more than 3/4 inch in diameter; or with stem girdling roots are unacceptable.
2. Collected Stock: Do not use plants harvested from the wild, from native stands, from an established landscape planting, or not grown in a nursery unless otherwise indicated.

B. Provide plants of sizes, grades, and ball or container sizes complying with ANSI Z60.1 for types and form of plants required. Plants of a larger size may be used if acceptable to Architect, with a proportionate increase in size of roots or balls.

C. Root-Ball Depth: Furnish trees and shrubs with root balls measured from top of root ball, which begins at root flare according to ANSI Z60.1. Root flare shall be visible before planting.

D. Labeling: Label each plant of each variety, size, and caliper with a securely attached, waterproof tag bearing legible designation of common name and full scientific name, including genus and species. Include nomenclature for hybrid, variety, or cultivar, if applicable for the plant.

E. If formal arrangements or consecutive order of plants is indicated on Drawings, select stock for uniform height and spread, and number the labels to assure symmetry in planting.

F. Annuals and Biennials: Provide healthy, disease-free plants of species and variety shown or listed, with well-established root systems reaching to sides of the container to maintain a firm ball, but not with excessive root growth encircling the container. Provide only plants that are acclimated to outdoor conditions before delivery.

2.2 FERTILIZERS

A. Planting Tablets: Tightly compressed chip-type, long-lasting, slow-release, commercial-grade planting fertilizer in tablet form. Tablets shall break down with soil bacteria, converting nutrients into a form that can be absorbed by plant roots.

1. Size: 21-gram tablets.
2. Nutrient Composition: 20 percent nitrogen, 10 percent phosphorous, and 5 percent potassium, by weight plus micronutrients.

2.3 MULCHES

A. Organic Mulch: Free from deleterious materials and suitable as a top dressing of trees and shrubs, consisting of one of the following:

1. Type: Wood and bark chips
2. Size Range: 3 inches maximum, 1/2 inch minimum
3. Color: Natural.

B. Compost Mulch: Well-composted, stable, and weed-free organic matter, pH of 5.5 to 8; moisture content 35 to 55 percent by weight; 100 percent passing through a 1-inch sieve; soluble-salt content of 2 to 5 dS/m; not exceeding 0.5 percent inert contaminants and free of substances toxic to plantings; and as follows:

1. Organic Matter Content: 50 to 60 percent of dry weight.
2. Feedstock: Agricultural, food, or industrial residuals; biosolids; yard trimmings; or source-separated or compostable mixed solid waste.

C. Mineral Mulch: Hard, durable stone, washed free of loam, sand, clay, and other foreign substances, of the following type, size range, and color:

1. Type: Decomposed Granite
2. Size Range: 1/2 inch Screened
3. Color: Apache Gold or color range acceptable to Landscape Architect

D. Stabilized Decomposed Granite:
1. Type: Decomposed Granite
2. Size Range: ¼" Screened
3. Color: Express Rose or color range acceptable to Landscape Architect.
   a. Acceptable local Suppliers:
      1) AAA Landscape
      2) Kalamazoo Construction
      3) Grey Rock

2.4 STABILIZER BINDER

A. Patented, non-toxic, organic binder that is a colorless and odorless concentrated powder that binds decomposed granite together to produce a firm surface.

B. Provided by Stabilizer Solutions, Inc. 1-800-336-2468 or approved equal.

2.5 WEED-CONTROL BARRIERS

A. Nonwoven Geotextile Filter Fabric: Polypropylene or polyester fabric, 3 oz./sq. yd. minimum, composed of fibers formed into a stable network so that fibers retain their relative position. Fabric shall be inert to biological degradation and resist naturally encountered chemicals, alkalis, and acids.

B. Composite Fabric: Woven, needle-punched polypropylene substrate bonded to a nonwoven polypropylene fabric, 4.8 oz./sq. yd.

2.6 PESTICIDES

A. General: Pesticide registered and approved by the EPA, acceptable to authorities having jurisdiction, and of type recommended by manufacturer for each specific problem and as required for Project conditions and application. Do not use restricted pesticides unless authorized in writing by authorities having jurisdiction.

B. Pre-Emergent Herbicide (Selective and Nonselective): Effective for controlling the germination or growth of weeds within planted areas at the soil level directly below the mulch layer.

C. Post-Emergent Herbicide (Selective and Nonselective): Effective for controlling weed growth that has already germinated.

2.7 TREE-STABILIZATION MATERIALS

A. Trunk-Stabilization Materials:

1. Upright and Guy Stakes: 2-by-2-inch nominal by 8'-0" Fir or or 2" diameter 8'-0" long Lodgepole Pine, pointed at one end. Stakes shall be rough-sawn, sound, new and free of knots, holes, cross grain, and other defects,
2. Guys and Tie Wires: ASTM A 641/A 641M, Class 1, galvanized-steel wire, two-strand, twisted, 0.106 inch in diameter with new rubber hose or strap to protect tree.
3. Guy Cables: Five-strand, 3/16-inch diameter, galvanized-steel cable, with zinc-coated turnbuckles, a minimum of 3 inches long, with two 3/8-inch galvanized eyebolts.

B. Root-Ball Stabilization Materials:

1. Upright Stakes and Horizontal Hold-Down: Rough-sawn, sound, new hardwood or softwood, free of knots, holes, cross grain, and other defects, 2-by-2-inch nominal by length indicated; stakes pointed at one end.
2. Wood Screws: ASME B18.6.1.

2.8 LANDSCAPE EDGINGS

A. Steel Edging: Standard commercial-steel edging, fabricated in sections of standard lengths, with loops stamped from or welded to face of sections to receive stakes.

1. Edging Size: 1/4 inch thick by 5 inches deep.
2. Stakes: Tapered steel, a minimum of 12 inches long.
3. Accessories: Standard tapered ends, corners, and splicers.
4. Finish: Unfinished

2.9 MISCELLANEOUS PRODUCTS

A. Root Barrier: Black, molded, modular panels 18 inches deep, 85 mils thick, and with vertical root deflecting ribs protruding 3/4 inch out from panel surface; manufactured with minimum 50 percent recycled polyethylene plastic with UV inhibitors.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas to receive plants, with Installer present, for compliance with requirements and conditions affecting installation and performance of the Work.

1. Verify that no foreign or deleterious material or liquid such as paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, or acid has been deposited in soil within a planting area.
2. Verify that plants and vehicles loaded with plants can travel to planting locations with adequate overhead clearance.
3. Suspend planting operations during periods of excessive soil moisture until the moisture content reaches acceptable levels to attain the required results.
4. Uniformly moisten excessively dry soil that is not workable or which is dusty.

B. If contamination by foreign or deleterious material or liquid is present in soil within a planting area, remove the soil and contamination as directed by Architect and replace with new planting soil.

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

3.2 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities and turf areas and existing plants from damage caused by planting operations.

B. Install erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.

C. Lay out individual tree and shrub locations and areas for multiple plantings. Stake locations, outline areas, adjust locations when requested, and obtain Architect's acceptance of layout before excavating or planting. Make minor adjustments as required.

D. Lay out plants at locations directed by Architect. Stake locations of individual trees and shrubs and outline areas for multiple plantings.

3.3 PLANTING AREA ESTABLISHMENT

A. General: Prepare planting area for soil placement and mix planting soil according to Section 329113 "Soil Preparation."

B. Placing Planting Soil: Place and mix planting soil in-place over exposed subgrade.

C. Before planting, obtain Architect's acceptance of finish grading; restore planting areas if eroded or otherwise disturbed after finish grading.

3.4 EXCAVATION FOR TREES AND SHRUBS

A. Planting Pits and Trenches: Excavate circular planting pits.

1. Excavate planting pits with sides sloping inward at a 45-degree angle. Excavations with vertical sides are unacceptable. Trim perimeter of bottom leaving center area of bottom raised slightly to support root ball and assist in drainage away from center. Do not further disturb base. Ensure that root ball will sit on undisturbed base soil to prevent settling. Scarify sides of planting pit smeared or smoothed during excavation.
2. Excavate approximately three times as wide as ball diameter for balled and burlapped or container-grown stock.
3. Excavate at least 12 inches wider than root spread and deep enough to accommodate vertical roots for bare-root stock.
4. Do not excavate deeper than depth of the root ball, measured from the root flare to the bottom of the root ball.
5. If area under the plant was initially dug too deep, add soil to raise it to the correct level and thoroughly tamp the added soil to prevent settling.
6. Maintain angles of repose of adjacent materials to ensure stability. Do not excavate subgrades of adjacent paving, structures, hardscapes, or other new or existing improvements.
7. Maintain supervision of excavations during working hours.
8. Keep excavations covered or otherwise protected after working hours.
9. If drain tile is indicated on Drawings or required under planting areas, excavate to top of porous backfill over tile.

B. Backfill Soil: Subsoil and topsoil removed from excavations may not be used as backfill soil unless otherwise indicated.

C. Obstructions: Notify Architect if unexpected rock or obstructions detrimental to trees or shrubs are encountered in excavations.

1. Hardpan Layer: Drill 6-inch diameter holes, 24 inches apart, into free-draining strata or to a depth of 10 feet, whichever is less, and backfill with free-draining material.

D. Drainage: Notify Architect if subsoil conditions evidence unexpected water seepage or retention in tree or shrub planting pits.

E. Fill excavations with water and allow to percolate away before positioning trees and shrubs.

3.5 TREE, SHRUB, AND VINE PLANTING

A. Inspection: At time of planting, verify that root flare is visible at top of root ball according to ANSI Z60.1. If root flare is not visible, remove soil in a level manner from the root ball to where the top-most root emerges from the trunk. After soil removal to expose the root flare, verify that root ball still meets size requirements.

B. Roots: Remove stem girdling roots and kinked roots. Remove injured roots by cutting cleanly; do not break.

C. Balled and Burlapped Stock: Set each plant plumb and in center of planting pit or trench with root flare 1 inch above adjacent finish grades.

1. Backfill: Mixed Planting Soil
2. After placing some backfill around root ball to stabilize plant, carefully cut and remove burlap, rope, and wire baskets from tops of root balls and from sides, but do not remove from under root balls. Remove pallets, if any, before setting. Do not use planting stock if root ball is cracked or broken before or during planting operation.
3. Backfill around root ball in layers, tamping to settle soil and eliminate voids and air pockets. When planting pit is approximately one-half filled, water thoroughly before placing remainder of backfill. Repeat watering until no more water is absorbed.
4. Place planting tablets equally distributed around each planting pit when pit is approximately one-half filled. Place tablets beside the root ball about 1 inch from root tips; do not place tablets in bottom of the hole.

    a. Quantity: Add Fertilizer tablets in plant pit as follows:
        1) One Gallon Shrubs – 1 tablet
        2) Five Gallon Shurb/Tree – 3 tablets
        3) 15 Gallon Tree – 4 tablets

5. Continue backfilling process. Water again after placing and tamping final layer of soil.

D. Balled, Potted and Container-Grown Stock: Set each plant plumb and in center of planting pit or trench with root flare 1 inch above adjacent finish grades.

1. Backfill: Mixed Planting soil
2. Carefully remove root ball from container without damaging root ball or plant.
3. Backfill around root ball in layers, tamping to settle soil and eliminate voids and air pockets. When planting pit is approximately one-half filled, water thoroughly before placing remainder of backfill. Repeat watering until no more water is absorbed.
4. Place planting tablets equally distributed around each planting pit when pit is approximately one-half filled. Place tablets beside the root ball about 1 inch from root tips; do not place tablets in bottom of the hole.

a. Quantity: Add Fertilizer tablets in plant pit as follows:
    1) One Gallon Shrubs – 1 tablet
    2) Five Gallon Shurb/Tree – 3 tablets
    3) 15 Gallon Tree – 4 tablets

5. Continue backfilling process. Water again after placing and tamping final layer of soil.

E. Slopes: When planting on slopes, set the plant so the root flare on the uphill side is flush with the surrounding soil on the slope; the edge of the root ball on the downhill side will be above the surrounding soil. Apply enough soil to cover the downhill side of the root ball.

3.6 TREE, SHRUB, AND VINE PRUNING

A. Remove only dead, dying, or broken branches. Do not prune for shape.

B. Prune, thin, and shape trees, shrubs, and vines as directed by Architect.

C. Prune, thin, and shape trees, shrubs, and vines according to standard professional horticultural and arboricultural practices. Unless otherwise indicated by Architect, do not cut tree leaders; remove only injured, dying, or dead branches from trees and shrubs; and prune to retain natural character.

D. Do not apply pruning paint to wounds.

3.7 TREE STABILIZATION

A. Trunk Stabilization by Upright Staking and Tying: Install trunk stabilization as follows unless otherwise indicated:

1. Upright Staking and Tying: Stake trees of 2- through 5-inch caliper. Stake trees of less than 2-inch (50-mm) caliper only as required to prevent wind tip out. Use a minimum of two stakes of length required to penetrate at least 18 inches below bottom of backfilled excavation and to extend to the dimension indicated on Drawings above grade. Set vertical stakes and space to avoid penetrating root balls or root masses.
2. Upright Staking and Tying: Stake trees with two stakes for trees up to 12 feet high and 2-1/2 inches or less in caliper; three stakes for trees less than 14 feet high and up to 4 inches in caliper. Space stakes equally around trees.
3. Support trees with bands of flexible ties at contact points with tree trunk. Allow enough slack to avoid rigid restraint of tree.
4. Support trees with two strands of tie wire, connected to the brass grommets of tree-tie webbing at contact points with tree trunk. Allow enough slack to avoid rigid restraint of tree.

3.8 ROOT-BARRIER INSTALLATION

A. Install root barrier where trees are planted within 60 inches of paving or other hardscape elements, such as walls, curbs, and walkways, unless otherwise indicated on Drawings.

B. Align root barrier vertically, and run it linearly along and adjacent to the paving or other hardscape elements to be protected from invasive roots.

C. Install root barrier continuously for a distance of 60 inches in each direction from the tree trunk, for a total distance of 10 feet per tree. If trees are spaced closer, use a single continuous piece of root barrier.

1. Position top of root barrier flush with finish grade.
2. Overlap root barrier a minimum of 12 inches at joints.
3. Do not distort or bend root barrier during construction activities.
4. Do not install root barrier surrounding the root ball of tree.

3.9 PLACING SOIL IN PLANTERS

A. Place a layer of drainage gravel at least 4 inches thick in bottom of planter. Cover bottom with filter fabric and wrap filter fabric 4 inches up on all sides. Duct tape along the entire top edge of the filter fabric, to secure the filter fabric against the sides during the soil-filling process.

B. Fill planter with planting Mixed Planting Soil. Place soil in lightly compacted layers to an elevation of 1-1/2 inches below top of planter, allowing natural settlement.

3.10 GROUND COVER AND PLANT PLANTING

A. Set out and space ground cover and plants other than trees, shrubs, and vines as indicated on drawings in even rows with triangular spacing.

B. Use Mixed Planting Soil for backfill.

C. Dig holes large enough to allow spreading of roots.

D. For rooted cutting plants supplied in flats, plant each in a manner that minimally disturbs the root system but to a depth not less than two nodes.

E. Work soil around roots to eliminate air pockets and leave a slight saucer indentation around plants to hold water.

F. Water thoroughly after planting, taking care not to cover plant crowns with wet soil.

G. Protect plants from hot sun and wind; remove protection if plants show evidence of recovery from transplanting shock.

3.11 PLANTING AREA MULCHING

A. Install weed-control barriers before mulching according to manufacturer's written instructions. Completely cover area to be mulched, overlapping edges a minimum of 6 inches secure seams with galvanized pins.

B. Mulch backfilled surfaces of planting areas and other areas indicated with Mineral Mulch (Decomposed Granite - 1/2 inch minus) as indicated on drawings to depth of 3 inches.

3.12 EDGING INSTALLATION

A. Steel Edging: Install steel edging where indicated according to manufacturer's written instructions. Anchor with steel stakes spaced approximately 30 inches apart, driven below top elevation of edging.

B. Mow-Strip Installation:

1. Excavate for mow strip as indicated on drawings.
2. Compact subgrade uniformly beneath mow strip.
3. Apply nonselective, pre-emergent herbicide that inhibits growth of grass and weeds.
4. Install steel edging, delineating the edge of mow strip.
5. Install weed-control barrier before mulching, covering area of mow strip, and overlapping and pinning edges of barrier at least 6 inches and according to manufacturer's written instructions.
6. Place indicated thickness of mineral mulch, fully covering weed barrier.
7. Rake mulch to a uniform surface level with adjacent finish grades.

3.13 STABILIZED DECOMPOSED GRANITE INSTALLATION

A. Blending Stabilizer:

1. Blend 12-16 lbs. of stabilizer per ton of decomposed granite. It is critical that stabilizer be thoroughly and uniformly mixed throughout decomposed granite.

B. Placement Of Decomposed Granite:

1. Upon thorough moisture penetration, compact aggregate screenings to 95% relative compaction by compaction equipment such as: double drum roller (2-4 ton), single drum roller (1000 lbs.), or vibratory plate tamp.
2. Do not begin compaction for 6 hours after placement and up to 48 hours. Take care in compacting decomposed granite when adjacent to planting and irrigation systems.

C. Repairs and Protection:
1. Remove and replace stabilized decomposed granite paving that is damaged, defective or does not meet the requirements of this section.

3.14 PLANT MAINTENANCE

A. Maintain plantings by pruning, cultivating, watering, weeding, fertilizing, mulching, restoring planting saucers, adjusting and repairing tree-stabilization devices, resetting to proper grades or vertical position, and performing other operations as required to establish healthy, viable plantings.

B. Fill in, as necessary, soil subsidence that may occur because of settling or other processes. Replace mulch materials damaged or lost in areas of subsidence.

C. Apply treatments as required to keep plant materials, planted areas, and soils free of pests and pathogens or disease. Use integrated pest management practices when possible to minimize use of pesticides and reduce hazards. Treatments include physical controls such as hosing off foliage, mechanical controls such as traps, and biological control agents.

3.15 PESTICIDE APPLICATION

A. Apply pesticides and other chemical products and biological control agents according to authorities having jurisdiction and manufacturer's written recommendations. Coordinate applications with Owner's operations and others in proximity to the Work. Notify Owner before each application is performed.

B. Pre-Emergent Herbicides (Selective and Nonselective): Apply to tree, shrub, and ground-cover areas according to manufacturer's written recommendations. Do not apply to seeded areas.

C. Post-Emergent Herbicides (Selective and Nonselective): Apply only as necessary to treat already-germinated weeds and according to manufacturer's written recommendations.

3.16 REPAIR AND REPLACEMENT

A. General: Repair or replace existing or new trees and other plants that are damaged by construction operations, in a manner approved by Architect.

1. Submit details of proposed pruning and repairs.
2. Perform repairs of damaged trunks, branches, and roots within 24 hours, if approved.
3. Replace trees and other plants that cannot be repaired and restored to full-growth status, as determined by Architect.

B. Remove and replace trees that are more than 25 percent dead or in an unhealthy condition before the end of the corrections period or are damaged during construction operations that Architect determines are incapable of restoring to normal growth pattern.

C. Repairs of Stabilized Decomposed Granite paving.

1. Excavate damaged area to the depth of the stabilized aggregate and square up sidewalls.
2. If area is dry, moisten damaged portion lightly.
3. Pre-blended aggregate and stabilizer powder with the proper amount of aggregate in a concrete mixer.
4. Add water to the pre- blended aggregate and stabilizer. Thoroughly moisten mix with 25 to 35 gallons per ton of pre-blended material or to approximately 10% moisture content.
5. Apply moistened pre-blended aggregate to excavated area to finish grade.
6. Compact with an 8” to 10” hand tamp or 250 to 300 lb. roller (if area is high traffic such as cart path, driveway or parking lot, use a larger 1000 lb. roller). Keep traffic off areas for 12 to 48 hours after repair has been completed.

3.17 CLEANING AND PROTECTION

A. During planting, keep adjacent paving and construction clean and work area in an orderly condition. Clean wheels of vehicles before leaving site to avoid tracking soil onto roads, walks, or other paved areas.

B. Remove surplus soil and waste material including excess subsoil, unsuitable soil, trash, and debris and legally dispose of them off Owner's property.

C. Protect plants from damage due to landscape operations and operations of other contractors and trades. Maintain protection during installation and maintenance periods. Treat, repair, or replace damaged plantings.

D. After installation and before Substantial Completion remove nursery tags, nursery stakes, tie tape, labels, wire, burlap, and other debris from plant material, planting areas, and Project site.

E. At time of Substantial Completion, verify that tree-watering devices are in good working order and leave them in place. Replace improperly functioning devices.

3.18 MAINTENANCE SERVICE

A. Maintenance Service for Trees and Shrubs: Provide maintenance by skilled employees of landscape Installer. Maintain as required in "Plant Maintenance" Article. Begin maintenance immediately after plants are installed and continue until plantings are acceptably healthy and well established, but for not less than maintenance period below:

1. Maintenance Period: 18 months from date of Substantial Completion.

B. Maintenance Service for Ground Cover and Other Plants: Provide maintenance by skilled employees of landscape Installer. Maintain as required in "Plant Maintenance" Article. Begin maintenance immediately after plants are installed and continue until plantings are acceptably healthy and well established, but for not less than maintenance period below:

1. Maintenance Period: 18 months from date of Substantial Completion.

C. Maintenance of Stabilized Decomposed Granite:

1. Remove debris, such as paper, grass clippings, leaves or other organic material by mechanically blowing or hand raking the surface as needed.
2. During the first year, a minor amount of loose aggregate will appear on the surface (1/16 to 1/4 inch). If this material exceeds a ¼ inch, redistribute the material over the entire surface. Water thoroughly to the depth of 1”. Compact with power roller of no less than 1000 lbs. This process should be repeated as needed.
3. If cracking occurs, simply sweep fines into the cracks, water thoroughly and hand tamp with an 8” to 10” hand tamp plate
4. Maintenance Period: 18 months from date of Substantial Completion.

END OF SECTION 329300

SECTION 33 0000
SITE UTILITIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Excavation, Trenching, & Backfilling for Water & Wastewater Utilities.
2. Water and Wastewater Line Separation Requirements.
3. Water Mains and Appurtenances.
4. Wastewater Mains and Appurtenances.
5. Final Site Utility Inspection Requirements.

1.2 SUBMITTALS

A. Product Data: Pipe materials, pipe accessories, pipe fittings, valves, and accessories.

B. Manufacturer's Certificate: Products meet or exceed specified requirements.

C. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.

1.3 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record locations of pipe runs, connections, and manholes, cleanouts, and invert elevations.

1.4 QUALITY ASSURANCE

A. Perform Work according to Navajo Tribal Utility Authority Construction Requirements and Technical Specifications for Materials and Workmanship for Water and Wastewater Facilities.

1.5 EXISTING CONDITIONS

A. Field Measurements:

1. Verify field measurements prior to fabrication.
2. Indicate field measurements on Shop Drawings.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Furnish materials according to Navajo Tribal Utility Authority Construction Requirements and Technical Specifications for Materials and Workmanship for Water and Wastewater Facilities.

PART 3 - EXECUTION

3.1 PREPARATION

A. Protect and support existing utility lines and appurtenances as Work progresses.

3.2 INSTALLATION

A. Installation Standards: Install Work according to Navajo Tribal Utility Authority Construction Requirements and Technical Specifications for Materials and Workmanship for Water and Wastewater Facilities.

NAVAJO TRIBAL UTILITY AUTHORITY
CONSTRUCTION REQUIREMENTS

Reviewed by:
NAVAJO NATION and HIS STANDARDS COMMITTEE

TECHNICAL SPECIFICATIONS
FOR
MATERIALS AND WORKMANSHIP
FOR WATER AND WASTEWATER FACILITIES

REVISED SEPTEMBER 2008

TECHNICAL SPECIFICATIONS FOR MATERIAL AND WORKMANSHIPOF WATER AND WASTEWATER FACILITIES

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DRAWING STANDARDS AND LEGEND

DEFINITION OF TERMS:

Owner:	The organization or its representative authorizing and administering the construction project.
Contractor:	The organization or its representative performing the construction.
Operating Utility:	The organization or its representative operating the water and wastewater utility affected by the construction.
Roadway Authority:	The authority or agency with jurisdiction over the roadway.
Or Approved Equal (OAE):	A substitute in material that is considered by the **Operating Utility** to be equal to or better than the item listed in the specifications or standards.
NTUA:	The utility owner, **Navajo Tribal Utility Authority**

TECHNICAL PROVISIONS 1.0

TP 1.0 EXCAVATION, TRENCHING, AND BACKFILLING FOR WATER AND WASTEWATER UTILITIES

1.01 Scope of Work

The work covered by this section includes the furnishing of all plant, labor, tools, equipment, and material, and performing all operations in connection with excavating, trenching, and backfilling, for installations of all water/wastewater utility pipelines, related structures, and accessories. This includes the necessary clearing and grubbing, pavement cutting, compaction, pavement restoration, grading, and cleanup, all in accordance with these Technical Provisions and applicable drawings. The final installation also shall meet the requirements of Section 2.0, Water, and Wastewater Line Separation Requirements.

If there is a conflict between these Technical Provisions and any other section of the specifications and/or drawings, then the most stringent, as determined by the Owner and/or NTUA shall apply.

1.02 Layout and Staking

All layout and staking for site work shall be performed by a licensed engineer or land surveyor, approved by the Owner and/or NTUA, who is to be paid by the Contractor, unless other arrangements are negotiated. Copies of survey notes shall be submitted to the Owner and the NTUA, with one or more copies remaining on the job site at all times.

1.03 Protection of Excavations

The Contractor shall provide suitable sheathing, shoring, and bracing to protect all excavations as required, to provide safe working conditions as directed by the NTUA. and in conformance with applicable OSHA and all other safety regulations. The Contractor at his expense shall repair damages resulting from settlements, slides, cave-ins, flooding, pipeline breaks, and other causes. Suitable signs shall be so placed as to show in advance where construction, barricades, or detours exists.

The Contractor shall at all times perform his work to insure the least possible obstruction to traffic, inconveniences to the general public and residents in the vicinity of the work, and to insure the protection of persons and property in a manner satisfactory to the Owner and the NTUA.. No road or street shall be closed to the public except with the permission of the proper authority. Fire

hydrants on or adjacent to the work site shall be kept accessible to fire-fighting equipment at all times. Temporary provisions shall be made by the Contractor to insure the use of sidewalks, and the proper functioning of all gutters, sewer inlets, drainage ditches, and irrigation ditches.

1.04 Protection of Existing Utilities

It shall be the Contractor's responsibility to determine the locations of all known existing underground utilities not shown on the drawings and to confirm the exact locations of those existing utilities shown on the drawings. All existing utilities shall be protected from damage, during excavation and backfilling of trenches and if damaged, shall be repaired at the expense of the Contractor.

1.05 Excavation

1.05.01 General

It is expected that all excavation required for the performance of the work shall be made by open cut methods unless otherwise specified and shown on the drawings or as required by applicable permits.

1.05.02 Grading and Stacking

All grading in the vicinity of the construction shall be controlled to prevent surface water from flowing into the excavation. Any water accumulated in the excavation shall be removed by pumping or other approved method. During excavation, material suitable for embedment and backfilling shall be piled in an orderly manner, a sufficient distance back from the edges of the bank to avoid overloading and to prevent slides or cave-ins. Material unsuitable for backfilling shall be hauled from the job site and disposed of by the Contractor at approved disposal sites.

1.05.03 Pavement Cutting

Where it is necessary to remove sections of asphalt pavement, the asphalt shall be clean-cut with approved equipment in a neat line 6 inches back from the outside edge of the excavation, in order to provide a key when restored.

Where it is necessary to remove sections of concrete pavement, the concrete shall be saw-cut to a depth of not less than 1-1/2-inches with neat vertical lines in such a manner that the adjoining surfaces will not be damaged.

1.05.04 Rock Excavation

If given special consideration, rock is considered to exist when excavation cannot be accomplished using a 790E John Deere Class track hoe with a rock bucket, without stressing the machine. The NTUA shall be the sole party in determining the existence of rock and the appropriate means of removal. The quantity of rock shall be determined in cubic yards of material removed. All other trenching and excavations, regardless of materials encountered, equipments used, or methods required for excavation, will be unclassified.

1.05.05 Dewatering

The Contractor shall remove and dispose of all water entering the trenches and shall keep the trenches water free until the water or wastewater lines and other appurtenances are in place. In no case shall water, earth, or any foreign materials be allowed to enter the water or wastewater pipelines.

1.05.06 Excavation for Structures

Excavation for appurtenances such as manholes, valves, foundations, catch basins, culverts, subterranean formwork, and other structures shall be to the necessary depth and sufficient width to leave at least 12-inches of space between the structure's outer surface and the embankment or shoring used to stabilize the banks.

1.05.07 Over-Excavation

Whenever solid or loose rock, rocky soil with rocks larger than 3/4-inches in their largest dimension, or otherwise unsuitable soils which are incapable of properly supporting the pipe or structure are encountered in the trench bottom, all unsuitable material, as determined by the Owner and NTUA, shall be over-excavated to a minimum depth of 6-inches below the pipe or structure and removed.

Except at locations where over-excavation is required, care shall be exercised not to excavate below the depths indicated. In the event of accidental over-excavation, the trench bottom grade will be restored in the same manner as areas specified to be over-excavated.

1.05.08 Trench Excavation

The sides of all trenches for the installation of utility piping system shall be as nearly vertical as soil conditions will allow from ground level to the pipe. Except for the trenching of 1-inch water service lines, the width of the trench shall be a minimum of 16-inches and a maximum of 30-inches wider than the outside diameter of the pipe. Trench

excavation shall be centered on pipe alignment such that a minimum clearance of 8-inches is provided on each side of the pipe. Trench width above the level of the top of the pipe may be as wide as necessary for shoring or sheathing and for proper installation of the work.

The depth of all trenches shall be as indicated on the drawings. If not otherwise specified, the depth of all trenches shall be in accordance with the specifications for the installation of waterlines and wastewater lines.

Unless otherwise required by applicable permits, the maximum length of trench that may be left open at any one time shall not exceed 500 feet.

1.06 Placement and Compaction of Pipe Embedment and Backfill Material

1.06.01 Pipe Embedment

Pipe embedment: Pipe embedment is defined as that material required to bring the trench bottom up to surface grade and that material placed alongside and above the pipe to a level of at least 6-inches over the top of the pipe. Pipe embedment shall be selected earth or sand, which contain no stones, dry or frozen lumps greater than 3/4-inch in diameter, or other unsuitable material as defined by the NTUA. Embedment and the first 6-inches of backfill, above the top of the pipe in rock excavation shall be done in the presence of the NTUA. Any backfilling, done in violation of this provision shall be cause for removal and replacement of the embedment, at the expense of the Contractor even though the work is found to be in accordance with these specifications.

Bedding: Bedding is that portion of pipe embedment zone beneath the pipe. If the native soil is suitable for bedding, the bottom of the trench shall be accurately shaped to provide uniform bearing and support for the entire length of the pipe. Bell holes shall be excavated to provide minimum clearances of 2-inches below the couplings or bells. Imported bedding material shall likewise be placed to provide uniform and adequate longitudinal support under the pipe. Bedding material shall be placed and compacted in lifts not to exceed 6-inches in loose measure.

Haunching: Haunching is that portion of the pipe embedment zone from the bottom of the pipe to the spring line of the pipe. Haunching material shall be placed and hand tamped to provide adequate side support to the pipe while avoiding both vertical and lateral displacement of the pipe from proper alignment.

Initial Backfill: Initial backfill is that portion of the pipe embedment zone from the spring line of the pipe to a minimum of 6-inches above the top of the pipe. Initial backfill material shall be placed and

compacted in lifts not to exceed 6-inches in loose measure. Compaction shall be performed in such a manner so as to avoid damage and disturbance of the embedded pipe.

Final Backfill: Final backfill is defined as that material used in the area between the initial backfill and the existing ground surface. Material shall be placed and compacted in lifts not to exceed 6-inches in loose measure except as otherwise specified.

1.06.02 Compaction Requirements

Unless otherwise specified by permit issued by the roadway authority or by special arrangement between the NTUA, bedding, haunching, initial backfill, final backfill, and gravel resurfacing shall be compacted to the following percentages of the maximum density as determined by ASTM D1557. (If using Standard Proctor ASTM D-698, add 5% to all compaction requirements listed in the table below). In-place densities of materials shall be determined by the sand-cone method, ASTM D1556 or by the nuclear method, ASTM D2922.

Percent of Maximum Density - D1557

Backfill Location	Bedding Backfill	Haunching Backfill	Initial Backfill	Final Backfill
Roadway Rights-of-Way Within Roadway Prism	95% *	95%	95%	95%
Roadway Rights-of-Way Outside of Roadway Prism	90% *	90%	90%	95%
All Other Conditions	90%	90%	90%	90%

* or the existing condition within the undisturbed bottom of the trench.

1.06.03 Water Jetting

The introduction of water to the pipe embedment or final backfill material shall not be permitted as a means of compaction.

1.07 Imported Backfill

1.07.01 Imported Pipe Embedment

If the native soil is unsuitable, the Contractor shall import suitable pipe embedment material. Pipe embedment shall be select earth or sand which contains no stones, dry lumps, or frozen lumps greater than 3/4-inches in diameter and shall be defined as 100% passing 3/4-inches, 40-99% passing # 4 sieve and 30% or less passing # 200 sieve.

Unsuitable material is defined as solid or loose rock, soils with rocks larger than 3/4-inches in their largest dimension, or other unsuitable soils which are, as determined by the NTUA, incapable of properly supporting the pipe.

1.07.02 Imported Final Backfill

If the native soil is unsuitable for use as final backfill, the Contractor shall import suitable final backfill. Imported final backfill may be any material, which is locally available and is capable of being compacted to the required density. This material shall be free of boulders and rocks larger than 6-inches in their smallest dimension, frozen clumps of dirt, organic material, or rubble, which could damage the pipe.

1.08 Bedding and Backfill for Structures

1.08.01 Bedding

Bedding material for structures is defined as that material beneath the structure. This material shall be as specified in the standard detail for each structure.

1.08.02 Backfill

Backfill for structures is defined as that material from the bottom of the structure to the existing ground surface. This material and the required compaction of such shall be the same as that specified for in the final backfill on pipelines, or as specified in the drawings.

1.09 Settlement of Adjacent Structures

Throughout the 1-year warranty period, the Contractor shall be required to fill and compact any areas where settlement has taken place and shall also be responsible for the settlement of any adjacent structure or object caused by any excavation performed under his contract.

1.10 Surface Restoration and Resurfacing

1.10.01 Surface Restoration

The following requirements shall be followed unless alternative specifications are set forth by the roadway or other rights-of-way crossing permits, or as arranged between the NTUA and the NMDOT.

After the piping and structures have been installed and all backfilling completed, areas, which were disturbed, shall be brought to true grades.

All slopes shall be trimmed and dressed, and all surface graded to maintain existing drainages. All streets, alleys, driveways, sidewalks, curbs, or other surfaces, which have been disturbed or damaged, shall be resurfaced or replaced. The Contractor shall properly dispose of all excess excavated materials.

As required by the operating utility, the contractor shall install the utility brand Carsonite markers at all road crossings, water valves, fittings, junctions, connections, points of intersection, or at a minimum, every 1500 feet. Naturally, this would apply only within the rural areas, along stretches of roadways, or as requested by the operating utility. This is also a requirement for marking sewer manholes, cleanouts, and service connections.

1.10.02 Roadway Patching

Whenever existing roadways are disturbed during the course of construction, the Contractor shall restore the roadways to their original condition.

For ease of compaction, the Contractor may use well-graded gravel, crushed stone, or flowable fill as backfill, from a Ready Mix plant as approved by the appropriate roadway agency. The material shall be clean, varying in size from 3/8-inches to 1-1/4-inches, with not more than 10 percent of the material less than 3/8-inches in size and shall be compacted in 6-inch layers or as directed by the NMDOT. Flowable fill is defined as one bag concrete, with gradations of 100% passing the 3/8 sieve, and less than 25% passing the #200 sieve. The slump should be between 5-inches and 8-inches, and the 28-day strength should be between 50 and 150-PSI.

Surfacing shall be replaced where the roadway has gravel, crushed stone, asphaltic, or concrete surfacing. Gravel or crushed stone shall be replaced in quantities and locations as directed by or as required by the roadway permitting authority. Asphalt mix or concrete surfacing shall be replaced, in the case of asphalt, appropriately compacted in roadways to a depth equal to existing roadway surface but not less than 2-inches in asphalt or 6-inches in concrete. A compacted stabilized gravel or crushed stone base 6-inches in depth shall be placed in the roadway at all locations where surfacing is required prior to placement of the bituminous or concrete wear course, unless other requirements are stipulated by the roadway authority.

The Contractor shall obtain any and all necessary written permissions, easements, and permits from federal, state, and county agencies prior to beginning any roadway excavation.

TECHNICAL PROVISIONS 2.0

TP 2.0 WATER AND WASTEWATER LINE SEPARATION REQUIREMENTS

2.01 General

Water lines located near wastewater facilities present conditions for serious potential cross contamination. Protection from cross contamination can be provided by separation of the facilities and use of special piping materials. For measuring separation between pipes, all measurements shall be the clearances between pipes. (Pipe O.D. to pipe O.D.).

2.02 Horizontal Separation of Water and Wastewater Lines

When water and wastewater lines are laid parallel to each other, the horizontal distance between the water and wastewater lines shall not be less than 10 feet. Each line shall be laid in separate trenches. The requirements for this separation shall apply to all other buried utilities, except the distance may be reduced to 5 feet for secondary electric and gas distribution lines less than 60-PSIG; however, all stipulations of the electric, gas, or other sub-surface utilities shall be met.

When physical conditions such as an existing obstruction, will not allow the required 10-foot horizontal separation, the water and wastewater mains may be laid closer than 10 feet if the bottom of the water main is a minimum of 12 inches above the top of the wastewater main and prior written approval is granted by the NTUA.

2.03 Vertical Separation of Water and Wastewater Lines

2.03.01 Water Above Wastewater

When waterlines cross wastewater lines, the waterline shall cross above the wastewater line with a minimum vertical separation of 12 inches. If necessary, the depth of bury for the waterline may be reduced to 36 inches (normally 42 inches) at the crossing to maintain the 12-inch vertical separation. No joints in new waterlines shall be permitted within 10 feet of crossing a wastewater line.

2.03.02 Wastewater Above Water

When a waterline must cross below a wastewater line, the minimum vertical separation between the lines is 12 inches. Backfill of the trenches shall be compacted to provide adequate support to prevent settling of the wastewater line and damaging the water line.

For new water construction, the waterline shall be normal PVC water pipes with 20-foot pipe sections centered on the wastewater crossing. No joints of new waterline construction shall be permitted within 10 feet of crossing a wastewater line. While it is desirable to have all crossings perpendicular or normal, new waterlines (centered on the crossing) may cross under a wastewater line at a maximum of 25° from perpendicular.

For new wastewater construction, the wastewater line shall be ductile iron pipe with gasketed joints, or approved equal (OAE), with an 18-foot section centered on the crossing. No joints in new wastewater line construction shall be permitted within 9 feet of crossing a water line.

For water and wastewater lines crossing electric, gas, or other buried facilities; the standards established by that other specific utility must be met.

2.04 Water Main Separation from Wastewater Manholes

No waterline pipe shall pass through, under, or come into contact with any part of a wastewater manhole.

2.05 Water and Wastewater Service Line Separation Within 5 feet of the House

This section shall apply to that portion of water and wastewater service lines located within 5 feet of the house. All lines within 5 feet of the house will be considered as part of the house plumbing. For new construction, all service lines shall have a 10-foot minimum horizontal separation. This can be accomplished by having the water and wastewater service lines exit the house 10 feet apart or from different sides. If the 10-foot separation cannot be maintained and prior written approval is obtained from the NTUA, the service lines can be laid closer than 10 feet, if the bottom of the water service line is at least 12-inches above the top of the wastewater service line; and the water service line is continuous with no joints until the separation requirement is met.

2.06 Separations Between Waterlines and Components of the Wastewater Disposal System

Waterlines shall not be installed within 10 feet of a septic tank, within 25 feet of a drain field, or 50 feet from an outhouse. Also, waterlines shall not be installed within 100 feet of the perimeter fence of an **individual** lagoon, or within 500 feet of the perimeter fence of a **community** lagoon.

2.07 Separation Between Residences and Wastewater Lagoons

No permanent residence shall be within 1000 feet from the perimeter fence line of

a **community** sewer lagoon, or within 300 feet from the perimeter fence line of an **individual** sewer lagoon without written consideration of the Operating Utility.

TECHNICAL PROVISIONS 3.0

TP 3.0 WATER MAINS, WATER SERVICE LINES, AND APPURTENANCES

3.01 Scope of Work

The work covered by this section includes the furnishing of all labor, equipment and tools, and material; performing all operations in connection with the construction of water mains, including the placing of all necessary valves, hydrants, fittings, and appurtenances, and the construction of water service lines and appurtenances, in accordance with these technical provisions and applicable drawings.

3.02 Water Mains

3.02.01 Polyvinyl Chloride (PVC) Pipe and Fittings

Fittings for PVC pipe 4-inch and larger shall be Class 350 SSB mechanical joint, ductile iron conforming to AWWA C153 and shall be cement mortar-lined conforming to AWWA C104 or if shown on the plans, may be Class 200 PVC Bell and Gasket, conforming to ASTM D3139 and D1784, Type 1, Grade 1, and ASTM D2241.

PVC pipe shall conform to ASTM D2241 and the pipe shall be PVC 1120, SDR 21 and 200-PSI pressure rating or SDR 26 and 160-PSI, as specified on the plans. All PVC pipe joints shall be rubber compression ring type gaskets conforming to ASTM D3139 - Rieber type or equal. Special piping provisions are required when higher pressures are encountered.

Plastic pipe with scratches, gouges, or grooves deeper than one-tenth (0.10) of the wall thickness shall be rejected. Damaged sections of pipe shall be completely destroyed or immediately removed from the job site.

Ductile Iron pipe of specific class and type as shown on the plans may be required under certain circumstances. The pipe may require polyethylene encasement. In cases where the soil environment is corrosive -the soil resistivity is less than 1000 ohm-cm, the PH is less than 4 or greater than 8.5, or sulfides or high moisture content exist in the soil, etc. -the Contractor shall be required to wrap all mechanical joint fittings and all Ductile Iron pipe with 9 mill polyethylene film per AWWA C105/A21.5.

3.02.02 Water Main Installation

Pipe and fittings shall be installed generally in accordance with the manufacturer's printed instructions and specifications, to the standards of the AWWA for installing the type of pipe used, and in accordance with the NTUA Technical Provisions. Minimum bury depth shall be 42-inches, unless otherwise specified, with a maximum depth of 72-inches, unless specifically exempted by the NTUA Engineer.

Pipe and fittings shall be carefully handled to avoid damage. Dirt or other foreign material shall be prevented from entering the pipe or pipe joint during handling or laying operations and any pipe or fitting that has been installed with dirt or foreign material shall be removed, cleaned, and re-laid. When pipe installation is not in progress, the open ends of the pipe shall be closed with a watertight plug.

Long radius curves, either horizontal or vertical, may be installed with standard pipe by deflecting at the joints. The amount of deflection at each pipe joint shall not exceed the manufacturer's printed recommended deflections. When rubber gasket pipe is laid on a curve, the pipe shall be jointed in a straight alignment and then deflected to the curved alignment. Trenches shall be excavated wider on curves for this purpose.

3.02.03 Connections to Existing Mains

A permission to tap permit shall be obtained from the local NTUA office by the Contractor and all work shall be in conformance with said tapping permit.

Connections to existing mains shall be dry connections, made in a neat and workmanlike manner, unless otherwise permitted by the NTUA. Each connection to an existing waterline shall be made at a time and under conditions which will least interfere with water services to customers affected thereby, or as authorized by the NTUA and as evidenced by an approved tapping permit. Such connections shall be made to the satisfaction of the NTUA. Proper tools and fittings to suit actual conditions encountered in the field in each case shall be utilized. The cutting of pipe for inserting fittings or closure pieces shall be done in strict accordance with the recommendations of the pipe manufacturer, without damage to the pipe, or coating, and so as to leave a smooth end at right angle to the axis of the pipe.

Great care shall be taken to prevent pipeline contamination when

cutting into and making connections with existing pipelines used for the conveyance or distribution of water for domestic or public use. The Contractor shall coordinate and cooperate with the NTUA, in locating services and shall conduct his operations in such a manner that trench water, mud, or other contaminations are not allowed to enter the connected line or lines, at any time during the progress of the work. The interior of all pipe, fittings, and valves installed in such connections shall be thoroughly cleaned and then swabbed with or dipped in strong chlorine solution having a chlorine content of 200 parts per million (PPM).

3.03 Valves For Water Mains

3.03.01 Gate Valves

All gate valves shall conform to AWWA Specification C509, iron body, epoxy coated, bronze mounted, resilient wedge, counter clockwise opening, inside screw, non-rising stem with O-ring seals, and a 2-inch square wrench nut. Valve working pressure rating shall be 200-PSI minimum. The valves shall be Mueller, Kennedy, Waterous, Dresser M & H, Clow, or an approved equal (OAE) with mechanical joints as specified on the plans with appropriate transition gaskets. For operating pressures greater than 200-PSI, special considerations shall be followed.

3.03.02 Valve Boxes

Valve boxes shall be installed on all buried valves and shall be 5-1/4-inch nominal diameter shaft, two-piece adjustable screw type equal to Tyler No. 6850 Series. The length of the box shall be sufficient to permit access to the valve at the specified depth of bury. Tyler Series extensions will be utilized to extend the valve box where required. The word "Water" shall be cast onto the lid.

3.03.03 Valve Installation

Before installing the valve, care shall be taken to see that all foreign material and objects are removed from the interior of the valve. The valve shall be opened and closed to see that all moving parts are in working order, prior to installation.

All valves shall be set and jointed to the pipe in the manner as set forth in the AWWA Standards for the type of connecting ends furnished. All valves shall be set in and tied to poured in-place concrete support blocks as per the NTUA standard detail. Valves and valve boxes shall be set plumb. The cast iron valve boxes shall be placed over valves in such a

manner that the valve boxes do not transmit shock or stress to the valve. The valve box cover shall be set flush with, or slightly above the finished grade, as shown per the NTUA standard detail. A 2-foot square by 4-inch deep reinforced concrete pad shall be poured around each valve box. Before the concrete hardens, the Contractor shall neatly scribe in the concrete pad, the valve and pipe size and type, and a line indicating the direction of flow of water through the valve.

3.04 Fire Hydrant Assembly

3.04.01 Fire Hydrant

Fire hydrants shall be of standard manufacture with the name of the manufacturer and direction of opening cast on the hydrant top. Fire hydrants shall conform to AWWA C502. The end connections shall be mechanical joint. The hydrants shall be equipped with a breakaway safety flange and safety stem coupling at or near the bury line such that a heavy impact would minimize breakage of hydrant parts. The hydrants shall open counter clockwise, have a 5 1/4-inch or larger main valve opening, 6-inch inlet, 1 1/2-inch tapered pentagonal operating nut, 2 hose nozzles 2 1/2-inches in diameter, and a 4 1/2-inch pumper nozzle, all with National Standard hose threads. The hydrant shall be Mueller A423, Kennedy K81A, or an approved equal OAE.

3.04.02 Hydrant Connections and Auxiliary Gate Valves

An auxiliary gate valve and valve box shall be installed adjacent to each fire hydrant per the standard detail or as specified on the plans. The pipe between the fire hydrant and the auxiliary gate valve and between the auxiliary gate valve and the main shall be 6-inch minimum.

3.04.03 Fire Hydrant and Guard Installation

Before installing any hydrant, care shall be taken to see that all foreign materials and objects are removed from the interior of the barrel. The hydrant shall be opened and closed to see that all moving parts are in working order.

Hydrants shall be installed plumb with the pumper nozzle toward the street. The hydrant shall be set per the standard detail for the hydrant and guard.

3.05 Thrust Blocking

Thrust blocking as detailed in the standard drawings shall be placed at all bends, caps, tees, crosses, and fire hydrants. Blocking shall be concrete mix poured in

place. Concrete blocking shall bear against solid undisturbed earth at the sides and bottom of the trench excavation and shall be shaped so as not to block weep holes or obstruct access to the joints of the pipes or fittings. The concrete shall not cover nuts and bolts of joints or fittings. Ductile Iron Joint Restraints used in conjunction with Mechanical Joint fittings may be used as a substitute for concrete blocking.

3.06 Water Main Crossings

3.06.01 Wash Crossings

Water mains shall be installed as shown on the plans. The Contractor shall divert surface flows, conduct dewatering, and perform all steps necessary to maintain proper bedding conditions and alignment. A minimum 6-foot depth of bury is required at the centerline of all wash crossings.

3.06.02 Road Crossings

In lieu of boring, roads may be open cut for water line and casing installation. The original surface pavement on all open cut roadways shall be either cut square or sawed straight. As with open cut, if boring is required the steel conduit shall be extended from right-of-way to right-of-way. The Contractor shall obtain written permission from the appropriate agency prior to beginning any roadway excavation. Backfill within the limits of a roadway prism may require special compaction in accordance with the requirements of the roadway crossing permits.

Surfacing shall be replaced where the roadway has gravel, concrete, or asphaltic paving in the same thickness as were removed, or as specified by the roadway agency, and completed as soon as possible following backfilling.

Ductile iron pipes resting on the bells within the steel casing shall be used as the carrier pipes. PVC waterline road crossings may also be installed within the steel casing on approved casing chocks or redwood skids secured to the pipe with stainless steel straps. The casing ends shall be sealed with an approved rubber boot or 9-mil plastic sheeting with stainless steel clamps. Casing pipe shall be straight welded Schedule 10 steel pipe, .25-inch wall thickness, unless otherwise specified. An alternate method for roadway crossing is to install ductile iron pipe, Class 52, bell and spigot, direct bury by open cut excavation from right of way to right of way. This would be considered when crossing minor roads or trails, or for congested area within an urban setting.

For pressure testing purposes, gate valves will be required on the up stream and downstream side of roadway crossings.

3.07 Water Service Connections Material

3.07.01 Polyethylene (PE) Pipe

Polyethylene (PE) pipe shall be 1-inch IPS, 200 psi, SIDR 7 in conformance with ASTM D2239. The pipe shall be produced from a high density ultra-high molecular weight PE pipe compound, PE 3406 or PE 3408 which conforms to the latest revision of ASTM D1248. The pipe shall be equal to Driscopipe 5100 Ultral-line or Yardley Ultra-high Molecular Weight PE. The designation PE 3406 or PE 3408 shall be stamped on the pipe.

3.07.02 Service Line Fittings and Connections

Fittings and connections for PE pipe shall be made with non-flare compression connections and shall be Mueller Insta-Tite H-15426, or approved equal. All threaded connections from the water main to and including the inlet of the domestic stop shall be standard iron pipe (I.P.) threads.

3.07.03 Saddles

Saddles shall be specific for the type, size, and pressure rating of the mainline as recommended by the saddle manufacturer. Saddles shall be double strapped, double banded, or of the contoured band type. Saddles and saddle components shall be brass, bronze, or stainless steel. Tap threads shall be FIP. Acceptable saddles include Ford S71 and Mueller H-13478 for IPS PVC O.D. pipe, or Ford 202B or approved equal for DI and AC O.D. pipe.

3.07.04 Corporation Stops

Corporation stops shall be bronze alloy with MIP threads inlet by FIP threads outlet. They shall be equal to Mueller H-10046 corporation stops or Ford Type FB1700.

3.07.05 Curb Stops

Curb stops shall be 1-inch bronze alloy, quarter turn check, FIPT x FIPT end connections, with tee head and 30-inch (approx.) stationary operating rod. Curb stops shall be Minneapolis pattern top threads with resilient O-rings seals and equal to the Mueller B-20287, or Ford B11-444M or AY McDonald 6105.

3.07.06 Curb Stop Boxes

Curb stop boxes shall be the extension type, cast iron with 1 1/2-inch upper section. Curb box lid shall be cast iron and have a countersunk brass pentagon head plug. The curb stop boxes shall be Minneapolis pattern 2-inch base bushed to 1 1/2-inch and equal to Mueller H-10302 or Ford Type PXL. The finished elevation of the plug shall be such that it extends just slightly above the ground surface. The stationary rod shall be sized so that the top extends 2 to 4inches below the top of the curb box. An 18-inch by 18-inch by 4-inch depth reinforced concrete collar shall be poured around each curb box.

3.07.07 Water Meters

Water meters shall be of cast bronze construction with magnetic drive and a hermetically sealed register which reads in gallons. The meter shall accurately record flows from 1/4 to 20 gpm and shall be a 5/8-inch by 3/4-inch Sensus SR model with frost plate. The Sensus SR II model is not acceptable.

3.07.08 Meter Yokes/Coppersetters

Yokes or coppersetters for water meters shall have 3/4-inch ID x 12-inch riser, with a ball valve with padlock wing angle on the inlet, with a meter nut on the outlet side, and in the base, a 1-inch double purpose union swivel inlet and outlet connection. Yokes shall have an eye for the insertion of a cross brace and equal to Ford VB 72-12W-11-44 or AY McDonald 20-212WX-DD-44. The cross brace shall be a 1/2-inch OD PVC pipe or # 4 rebar 18-inches in length. The tandem coppersetter shall have an "S" tube with two bronze adapters, iron thread by meter nut, for the pressure regulators. The PRV shall be Watts Series 25AUB or approved equal.

3.07.09 Meter Boxes

Meter boxes shall be 20-inches diameter, 30-inches high nonmetallic by DFW or approved equal and shall be extended a minimum of 1-inch below the service line. The meter box lid shall be a cast iron, double lid cover with 11-1/2-inches lid opening, plastic or aluminum inner lid, and locking outer lid with pentagon head worm type lock. The meter box cover shall be equal to Castings model M 70.

3.07.10 Domestic Stops (Not part of the NTUA's facilities)

Domestic stops shall be a 1-inch bronze alloy, quarter turn check, FIPT x FIPT end connections, with tee head and 39-inch stationary operating

rod. They shall have resilient O-rings seals and equal to the Ford B11-444 or AY McDonald 610.

3.07.11 Domestic Stop Valve Boxes (Not part of the NTUA's facilities)

The domestic stop valve box shall consist of 3-inch diameter PVC-DWV pipe with a 3-inch hub by FIP threaded adapter with a 3-inch MIP threaded plug for the lid. The finished elevation of the plug shall be such that the stationary rod is located immediately below or within the plug so that the rod can be operated with an adjustable wrench from ground surface with the plug removed. The 3inch diameter PVC-DWV pipe shall be cut so that the top of the adapter extends 3 to 6-inches above ground surface.

3.08 Water Service Line Installation

Water service lines and appurtenances shall be installed in accordance with TP 1.0, Excavation, Trenching, and Backfilling for Water and Sewer Utilities, and TP 2.0, Water and Sewer Line Separation Requirements. A minimum of 3 feet of cover is required for water service lines.

Service lines shall be cut using tools specifically designed to leave a smooth, even, and square end on the pipe. The cut ends shall be reamed to the full inside diameter of the pipe. Pipe ends are to be connected using fittings which seal to the outside surface of the pipe which shall be cleaned to a sound smooth finish before installation. Splices shall be kept to a minimum and no splices shall be made within 10 feet of any sewer line.

All 1-inch service connections to water mains 4-inches or larger shall be made using saddles (tap tees are permitted for new construction). Service connections to 2-inch pipe shall be made using tees. Particular care shall be exercised to assure that the main is not damaged by the installation of the saddle. The saddle shall be aligned on the water main so that it is at a 45 degree angle above the springline of the pipe. The hole drilled into the pipe through the saddle shall be no smaller than 1/8-inch less than the size of the saddle.

Where required, the Contractor shall reconnect existing water service connections to the new water mains using materials specified herein. Individual pressure reducing valves, where required, shall be installed on a tandem meter yoke as shown on the standard detail. Prior to installation of the meter and connection to the building or house, the entire water service line and appurtenances shall be flushed.

3.09 Pressure Tests

Where any section of a waterline is provided with concrete thrust blocking for fittings or hydrants, the pressure tests shall not be conducted until at least 48 hours after installation of the concrete thrust blocking, unless otherwise specified.

3.09.01 Pressure Test

All labor, test equipment, water for testing; appurtenances and material, and performance of all operations in accordance with the specifications, are the responsibility of the Contractor.

All pipelines shall be tested for water tightness up to the individual service meter or domestic stop. The test equipment will not be provided, but is subject to inspection by the NTUA. Arrangements for water used in pipeline testing and payment for the water shall be coordinated with the local NTUA office. Pressure gauges used for pressure testing, shall be graduated at a maximum of 5-PSI increments. Two gauges will be used simultaneously for verification of the gauges functionality. Prior to the actual test, the pipeline shall be pressured to 10-PSI above the test pressure. The pressure will then be decreased to the test pressure, after the required time, so that gauge responsiveness can be observed.

The minimum test pressure shall be at least 160-PSI, measured at the lowest point of elevation in the test section. No section shall be tested that is greater than one mile in length or that has greater than 25-PSI pressure change, due to elevation. The test shall be conducted in such a manner that existing mains, services lines, and service user's plumbing are not damaged. Damage caused by testing shall be corrected at the expense of the Contractor. All connections, valves, blow-offs, hydrants, and house services up to the meter yoke shall be tested with the main, as far as are practicable. When testing piping systems designed to operate above 160-PSI, it will be tested as if it were rated at 160-PSI.

No air testing shall be allowed.

The test section shall be filled slowly with potable water and all air shall be vented from the line. The test shall not begin until the pipe has been filled with water for at least 24 hours to allow for absorption. The test shall have a minimum duration of two hours with the two-hour period beginning when the test pressure is attained and the pump ceases operation.

No pipe installed shall be accepted if the leakage is greater than that determined by the following formula:

$$Q = \frac{N*D*(P)^{1/2}}{7400}$$

in which,

Q = Allowable leakage in gallons per hour

N = Number of joints in the pipeline being tested, this "N" being the standard length of pipe furnished divided into the length being tested with no allowance for double gasket joint caused by use of couplings instead of integral bell pipe or for joints at branches, blow-offs, fittings, etc.

D = Nominal diameter of pipe in inches

P = The test pressure in PSI gauge as discussed in the third paragraph of this procedure.

During the test, the test pressure should not lose more than 5-PSIG without being pumped back up to the test pressure. The total of the gallons of water required to hold the test pressure during the two hours plus the amount of water required to return the line to the test pressure at the end of the two-hour test period is the total leakage. If the total leakage is less than the allowable leakage, the line can be accepted. All visible leaks will be repaired, regardless of the amount of leakage. Should the test on any section of the pipeline show leakage greater than the allowable leakage, the Contractor shall locate and repair the defective pipe, fitting, or joint until the leakage is within the allowable leakage for the two-hour test duration.

3.09.02 Observation of Tests

The NTUA shall witness the pressure testing of waterlines. Prior to the actual test, the Contractor shall have all equipment set up completely, ready for operation and shall have previously successfully performed the test to verify that the test section will pass. The Contractor shall notify both the NTUA and the NMDOT a minimum of three working days in advance of the date that the Contractor plans to perform the pressure tests.

The NTUA shall observe the testing to verify that the testing was performed according to the specifications and that the test data were properly and accurately recorded. The Contractor shall complete the required certification forms and submit them to the NTUA for approval. A letter of approval or disapproval of the test results will be sent from the Operating Utility to the Contractor.

3.10 Disinfection

A liquid chlorine solution shall be introduced continuously into one end of the system and allowed to flow along and through all lines and appurtenances to be disinfected until a minimum of 50-PPM of chlorine is detected at representative points throughout the line. A contact period of 24 hours shall be maintained before the system is flushed out with clean water until a maximum of 0.4-PPM chlorine residual is attained. All valves shall be operated several times during the 24-hour contact period.

After disinfection, the Contractor shall collect bacteriological samples for testing at his expense. A laboratory certified by the State Health Department or the U.S. Environmental Protection Agency shall perform the analysis. If an unsatisfactory bacteriological test result (positive result) is obtained, the system shall be disinfected and re-tested by the Contractor. This shall be repeated until a satisfactory bacteriological test (negative result) is obtained. Disinfection by introducing granular or tablet chlorine compounds in each pipe length is not an acceptable method of disinfection and will not be allowed.

EXHIBIT A OF TP-3
WATER LINE PRESSURE TEST CERTIFICATION

LOCATION OF LINE TESTED:_____
Include Project Name & Number

DATE(S) TEST WAS CONDUCTED: _____

GAUGES MANUFACTURER AND MODEL: 1) _____

2) _____

STANDARD LENGTH OF PIPE IN TEST SECTION: _____ FEET.

TEST SECTION:_____
(Sta.-Sta., Line No., etc.)

Length (Sta.-Sta.) Time-Start/End	Line Size/Type (Inch)	Pipe Pressure Rating (PSI)	Test Pressures (PSIG)	Observed Pressure Range (PSIG)	Total Leakage (Gal./2hrs.)	Allowable Leakage (Gal./2hrs.)

THE TEST AND ATTACHED INFORMATION IS CERTIFIED BY:

Signature/Printed Name: _____

Organization/Address: _____

Address: _____

Telephone Number: _____

TEST RESULTS CHECKED AND APPROVED ON: _____
Date

BY: _____ PASSED _____ FAILED _____
NTUA Representative

COPY OF APPROVAL OF TEST SENT TO: _____
Project Agency Involved

ON_____ BY_____
Date NTUA

EXHIBIT B OF TP-3

WATER LINE PRESSURE TEST WORKSHEET 1

Allowable Leakage: $Q=\frac{ND(P)^{1/2}}{7400}$

Q = Gallon per Hour

N = Total Length of Line Being Tested (ft) / Standard Length of Pipe (ft) = _____ = _____

D = Nominal Diameter of Pipe (inches) = _____

P = Test Pressure (psig) = _____

Allowable Leakage (2 Hour Test) = $2Q = \frac{ND\square(P)^{1/2}}{7400} \times 2 =$ _____ (Gals.)

Are the pressure gauges graduated at a maximum of 5-PSI increments? _____

Was the line pressured to 10 PSI above the test pressure so that the gauge responsiveness could be observed? _____

Is the length of the test section less than one mile? _____

Is the elevation difference between the highest and lowest points in the test section less than 57 feet? _____

Are the pipes in the test section the same pressure rating? _____

Description of Activity: Time:	Gauge Readings:	Amount of Water Added:
Total Time: Hrs.		Total: Gals.

Verified By: _____

NTUA Representative/Date

_____

Print Name/Title

EXHIBIT C OF TP-3

WATER LINE PRESSURE TEST WORKSHEET 2

Test Section: _____

(Sta-Sta, Line No., Etc.)

Length (Sta.-Sta.) Time: Start & End	Line Size & Type (Inch)	Pipe Pressure Rating (PSI)	Test Pressure (PSIG)	Observed Pressure Range (PSIG)	Total Leakage (Gal./2hrs.)	Allowable Leakage (Gal./2hrs.)

TECHNICAL PROVISIONS 4.0

TP 4.0 WASTEWATER MAINS AND APPURTENANCES

4.01 Scope of Work

The work covered by this section includes the furnishing of all labor, equipment, and material; performing all operations in connection with the construction of gravity wastewater mains and service lines, including manholes and other appurtenances, in accordance with these technical provisions and applicable drawings.

4.02 General

The wastewater line shall be constructed in the location and to the grade and size shown on the drawings or as directed in writing by the NTUA. Excavation, trenching, and backfilling shall be in accordance with TP 1.0 of these specifications. Inspection of wastewater lines and manhole connections shall be accomplished before backfilling, but work covered by this section will not be accepted until backfilling has been completed satisfactorily. Any section of wastewater that is found defective in material, alignment, and/or grade shall be corrected to the satisfaction of the NTUA and the NMDOT.

4.03 Materials

4.03.01 Polyvinyl Chloride (PVC) Wastewater Pipe

Except for extensions to dead ends of 400 feet or less where 6-inch is permitted, minimum wastewater main pipe size and slope, shall be 8-inch nominal diameter at 0.4% slope; and minimum wastewater service pipe size shall be 4-inch nominal diameter at 2.0% slope. All PVC wastewater pipe shall be made of materials conforming to the requirements of ASTM-D1784, Type I, Grade I for Rigid Polyvinyl Chloride compounds. The PVC wastewater pipe shall be SDR 35, Type PSM, with elastomeric gasket joints and shall meet the requirements of ASTM-D3034. The pipe shall have an integral bell with a solid cross section rubber ring, which has been factory assembled and securely locked in place to prevent displacement. Standard lengths shall be 20 feet.

4.03.02 Polyvinyl Chloride (PVC) Wastewater Pipe Fittings

All PVC wastewater pipe fittings shall be SDR 35, Type PSM, with elastomeric gasket joints and shall meet the requirements of ASTM D-3034. Service connections to new wastewater mains shall be wye fittings. Connections to existing wastewater mains may be wye saddles.

4.03.03 Ductile Iron Wastewater Pipe

Ductile Iron Pipe shall meet the requirements of AWWA C151, with either mechanical or push-on joints, with an interior lining of 40-mil polyurethane or ceramic epoxy and an exterior of standard bituminous coating. Thickness shall be Class 52 in all sizes.

4.03.04 Ductile Iron Wastewater Pipe Fittings

Service connections to ductile iron pipe shall be via saddle-type fittings equal to the " or AOE. Connections between wastewater PVC pipe and ductile iron pipe shall be via the appropriate size Calder coupling; however, the ductile iron pipe should be extended from manhole to manhole to minimize the use of adapters.

4.03.05 Pre-cast Concrete Manhole Sections

Manhole sections shall conform to ASTM C 478. A polyisoprene rubber connector meeting the material and performance requirements of ASTM C-923 and equal to the “A-Lok” Connector as manufactured by A-Lok Products Inc., Trenton, N.J., shall be used to seal between the pre-cast manhole and the sewer pipe. “Ram-Nek” flexible gasket or the “Butyl-Lok” preformed sealant tape by A-Lok Products, Inc., or an approved equal shall be used to seal between manhole sections, grade rings, and cover ring. Bottom manhole sections shall have integral pre-cast base or reinforced concrete floor slabs.

4.03.06 Manhole Covers and Frames

The frames and covers shall be cast iron, equivalent to a Deeter 1257, 330 pounds, with a Type C surface pick slot. The cover minimum opening shall be 24-inches in diameter with a 6-inch high ring. The lid shall not have any holes including pick holes, which penetrate the entire thickness of the lid. A ¾”-inch by 2-inch by 2-inch recessed slot with a ½-inch diameter pin, crossing the small dimension and centered along the long dimension, shall be provided in the lid, in lieu of a pick hole.

4.03.07 Manhole Steps

Manhole steps shall be made of ½-inch steel rod encapsulated with copolymer polypropylene or approved equal and shall conform to ASTM C478. The ALCO 12653A aluminum step is also acceptable. Steps shall have minimum projections of 4-inches, spaced no more than 16-inches apart, minimum overall widths of 14-inches, and thoroughly anchored into the walls.

4.03.08 Concrete

All concrete in addition to the concrete used in precast sections shall have a compressive strength of not less than 3,000 pounds per square inch at 28 days of age. The aggregates, Portland cement, and concrete shall comply with the provisions of ASTM C144 and C33, ASTM C150, Type II. The concrete mix shall be approved by the Owner and shall include no less than 5-1/2 bags of Portland cement per cubic yard. When directed by the Owner, the Contractor shall have compressive strength tests made of the concrete in accordance with ASTM Standard Specifications.

4.03.09 Wastewater Cleanout and Frame

Where required on the plans, a Neenah R1791A or approved equal cast iron cleanout cover and frame shall be used on all 8-inch wastewater cleanouts.

4.04 Installation of Wastewater Pipe

4.04.01 Pipe Laying

All trenching, excavation, and backfilling shall be performed in accordance with TP 1.0 of these specifications. The bottom of the trench shall be shaped to give substantial uniform bearing and support for each section for the entire length of the pipe. Bell holes shall be excavated to provide a minimum clearance of 2 inches below the coupling or bell. Pipe laying shall proceed upgrade, with the spigot end pointing in the direction of the flow. Each pipe shall be laid true to line and grade and in such manner as to form a close concentric joint with the adjoining pipe. As the work progresses, the interior of the sewer shall be cleared of all dirt and superfluous materials of every description. If the maximum width of the trench at the top of the pipe specified in TP 1.0 of these specifications is exceeded for any reason other than by direction, the Contractor shall install such concrete cradling, encasement, gravel base or other bedding as may be required to satisfactorily support the added load of the backfill.

Trenches shall be kept free from water and the pipe shall not be laid when conditions of the trench or the weather are unsuitable for such work. At all times when work is not in progress, all open ends of pipe and fittings shall be securely closed so that no trench water, earth, or other substances will enter the pipe.

4.04.02 Depth of Bury

All sewage collection lines shall be ductile iron if less than 3 feet of cover is provided within streets and less than 2 feet of cover is provided in all other areas.

4.04.03 Installation of Service Connections

Wye fittings shall be provided and installed for sewer service connections to new sewer mains. Service saddles are not appropriate for service connections to newly constructed sewer mains but may be used for connections to existing sewer mains. The wye shall be installed such that it is at about a 45-degree angle with the vertical.

4.05 Manhole Installation

4.05.01 General

Manholes shall be installed in the locations shown on the plans and shall be constructed in accordance with the standard details. Manholes shall be spaced no more than 400 feet apart, and shall be installed at every change in grade, pipe size, or direction.

The invert channel shall be smooth and U-shaped. The lower portion shall conform to the inside of the adjacent sewer section and the upper portion shall be greater in height than the diameter of the largest pipe. A minimum invert elevation drop of 1/10 of a foot from the entrance to the outlet shall be provided in all manholes where there is a change in direction or grade. Changes in size and grade of the channel shall be made gradually and evenly. The invert channel may be formed directly in the concrete, or where there is no change in grade or direction between incoming and outgoing sewers, may be constructed by laying a full section of sewer pipe through the manhole and cutting out the top half after the surrounding concrete has hardened.

The floor of the manhole outside the channel shall be smooth and shall slope toward the channel not less than one inch per foot and not more than 2-inches per foot. Drop inside the manhole shall not exceed 2 feet, measured from the invert of the inlet pipe to the invert of its corresponding channel. If the drop exceeds 2 feet, then a drop manhole shall be installed. A channel must be formed in the concrete of an ogee shape so there is no free drop. Joints between manhole sections, adjustment rings, and cover rings shall be sealed with Ram-Nek flexible gasket or approved equal; and a concrete collar shall be installed in accordance with the standard details.

All sewers extending from manholes shall be supported with compacted gravel from where the sewer pipe leaves the manhole to where the pipe is supported by undisturbed soil.

4.05.02 Connection to Existing Manhole

The Contractor shall obtain a tapping permit from the NTUA prior to making connections to existing manholes. The connection to the existing manhole shall be made in accordance with the approved plans. Care should be exercised when connecting to the existing manhole so that limited fracture and cracking will occur on the existing manhole. Also, placement of the new wastewater main should be correctly aligned to the invert elevation so as to allow for proper flow of sewage through the manhole. Excessive damage to the existing manhole or improper installation of the new wastewater main, as determined by the NTUA, shall be cause for replacement of the existing facilities within the construction area by the Contractor. This replacement shall be done to the satisfaction of the NTUA and NMDOT.

4.06 Wastewater Main Crossings

4.06.01 Wash Crossings

Wastewater mains shall be installed as shown on the approved plans. The Contractor shall divert surface flows, conduct dewatering, and perform all steps necessary to maintain proper bedding conditions and alignment.

4.06.02 Road Crossings

In lieu of boring, the roadway may be open cut for sewer line within casing installation. The original surface pavement on all open cut roadways shall be either cut square or sawed straight. As with open cut, if boring is required, the steel casing shall be extended from right of way to right of way. The Contractor shall obtain written permission from the appropriate agency prior to beginning any roadway excavation. Backfill within the limits of a roadway prism may require special compaction in accordance with the roadway crossing permits.

Surfacing shall be replaced where the roadway has gravel, concrete, or asphaltic paving in the same thicknesses as were removed, or as specified by the Owner, and completed as soon as possible following backfilling.

PVC wastewater line road crossings shall be installed within steel casing on acceptable casing chocks or redwood skids secured to the pipe

with stainless steel straps. Ductile Iron pipe resting on the bells also may be used as the carrier pipes. The casing ends shall be sealed with an approved rubber boot or 9 mil plastic sheeting with stainless steel clamps. Casing pipe shall be straight welded SCH 10 steel pipe ¼" wall unless otherwise specified. An alternative method for roadway crossing is to install ductile iron pipe, Class 52, bell and spigot, direct bury by open cut excavation from right of way to right of way. This would be considered when crossing minor roads or trails, or for congested area within an urban setting.

A manhole shall be installed on each side of the roadway right of way, unless specified otherwise. The minimum grade of all road crossings should be 1.0% unless exempted by the NTUA and the NMDOT.

4.07 Sewer Service Line Installations (Not part of the Utility company's facilities)

4.07.01 General

All trenching, excavating, and backfilling should be performed in accordance with TP 1.0 and TP 2.0 of these specifications. All new construction shall provide a minimum slope of 1/4-inch per foot (2%) and maintain at least 2 feet of cover over the line. Clean outs should be placed at the house, at any in-line bend greater than 45 degree, and at 100-feet intervals. Bends greater than 45 degrees are discouraged. Services should not enter a manhole but should enter the main line at least 10 feet either side of the manhole.

4.07.02 Connection to Wyes or Main

Sewer service lines should be connected to the sewer wyes provided with the new sewer main. If connecting to an existing main without existing wyes, the connections shall be made with wye saddles. The Contractor shall obtain from the Operating Utility tapping permits before making sewer service connections to existing sewer mains. The saddle shall be aligned on the sewer main such that it is at about a 45 degree angle with vertical and in no case shall deviate, by more than 15 degrees from either side of 45 degrees without prior approval. During the installation of the sewer saddle, the Contractor shall not allow the pipe cutout or other foreign objects to enter the sewage collection system.

4.08 Wastewater Line Testing

4.08.01 Alignment Test

The Contractor shall notify the NTUA two working days in advance of

the date that the Contractor is ready for inspection of sewer alignment. The wastewater main shall be checked by the Contractor and verified by the NTUA, to determine whether any displacement of the pipe has occurred, after the trench has been backfilled to 2 feet above the pipe and tamped as specified. The test shall be made as follows: A light shall be flashed between ends of line by means of a flash light or reflected light. Any deviation from true line or grade, causing less than a full lamped circle, may be cause for rejection. Any ponding of water in the wastewater line may be cause for rejection. A full lamp circle is when a full circle of light is seen from any position around the pipe perimeter.

4.08.02 Deflection Test

The maximum allowable deflection (reduction in vertical inside diameter) for PVC pipe shall be five percent. Deflection testing may not be required in all cases; however, the NTUA reserves the right to require the Contractor to perform random deflection tests. If three successive tests are determined to be unsatisfactory, the Contractor shall perform deflection tests on the entire project. All locations with excessive deflection shall be excavated and repaired by re-bedding or replacement of pipe. Acceptable methods of deflection testing include use of properly sized go-no-go mandrels or other proposals suitable to the operating utility.

4.08.03 Ex-filtration Test

The Contractor shall conduct an ex-filtration test on each section of wastewater mains between manholes. The Contractor shall provide at his own expense all necessary equipment and materials required for the tests. One of the following testing methods shall be used.

Air Testing: Testing equipment shall be equal to the "Air-Loc" low pressure air testing system manufactured by Cherne Industrial, Inc. of Edina Minnesota. The gauge used for the air test shall have a minimum division of 0.10-PSI.

Testing shall be conducted in accordance with ASTM C924 (Testing Sewer Lines by the Low-Pressure Air Test Method), except as modified herein. Air testing shall be done between consecutive manholes throughout the entire length of the installed line. Air shall be added to the plugged test section until the internal air pressure reaches 4.0 psig. At least two minutes shall be allowed for the air pressure to stabilize. The air supply shall then be disconnected and the time required for the pressure to drop from 3.5 to 3.0 psig shall be measured with a stopwatch. No one shall enter a manhole when a line into it is

pressurized. If the groundwater level is above any portion of the test section, the test pressure shall be increased, by an amount equal to the average hydrostatic pressure of the groundwater.

The test section will be accepted if the time required for the pressure to decrease from 3.5 to 3.0 PSIG is equal to or greater than the time in the following table. The pipe diameter shall be based on the nominal size of the sewer main. If the time measured is less than the time specified in the table, the Contractor shall locate and repair any leaks and retest the sewer until it is acceptable.

Minimum Duration for Pressure Drop (400 feet Max.)	
Pipe Diameter (Inches)	Time (Minutes)
4	2.5
6	4.0
8	5.0
10	6.5
12	7.5

The following formula should be utilized to determine the minimum duration for pressure drop for test sections greater than 400 feet or pipe sizes greater than 12 inches.

$$T = 0.000371 \cdot D^2 \cdot L \div 2$$

Where: T = Time in Minutes
D = Nominal Diameter in Inches
L = Pipe Length in Feet

Water Testing: One gallon of water may be lost in 2 hours, per each section between manholes, when testing any size main up to 12-inches. The line shall not be tested with the manhole. At least 4 feet of head shall be used for the test. Service lines need not be tested, but they must be plugged to conduct the test of the main. If any leakage in excess of the allowable occurs in any section of the sewerline, that section(s) shall be repaired and re-tested after the leaks are located.

4.08.04 Groundwater Infiltration

Infiltration of groundwater in excess of 200 gallons per day per inch diameter per mile of wastewater line indicates that the line is not

watertight. Infiltration less than this amount does not relieve the Contractor of the requirement to perform ex-filtration testing. If excess infiltration is noted after ex-filtration tests have been completed, it shall be considered as evidence that the original test was in error or that subsequent failure of the pipeline has occurred.

4.09 Manhole Testing

Manholes shall be tested for water tightness. Each manhole shall be tested by itself. All lift holes shall be plugged with an approved non-shrink grout. All mains into and out of the manhole shall be plugged with a suitable device. If the manhole fails the initial test, necessary repairs shall be made and the manhole shall be retested. One of the following methods shall be used.

Vacuum Testing: Vacuum testing should be conducted, in accordance with ASTM C1244 (Vacuum Test for Concrete Manholes), except as modified below. The vacuum test head shall be placed inside the top section and the seal inflated in accordance with the manufacturers' recommendations. A vacuum of 10-inches of mercury shall be drawn and the vacuum pump shut off. With the valves closed, the time shall be measured for the vacuum to drop to 9-inches. The manhole shall pass if the time is greater than 60 seconds for 48-inches diameter, 75 seconds for 60-inches, and 90 seconds for 72-inches diameter manholes.

Hydrostatic Testing: Hydrostatic testing shall be conducted in accordance with ASTM C969, except as modified below. The manhole shall be filled with water to the ring. The maximum loss shall be 5 gallons in a 2-hour test regardless of the manhole depth. The amount of loss shall be determined by measuring the volume of water required to maintain the water level in the manhole within 2-inches of the top of the cone or flat top throughout the entire duration of the 2-hour test.

4.10 Observation of Pressure Tests

The NTUA is to witness the pressure testing of wastewater lines and manholes. Prior to the test, the Contractor shall have all equipment set up, completely ready for operation and shall have previously successfully performed the test to verify that the test section or manhole will pass. The Contractor shall notify both the NTUA and the NMDOT, a minimum of two working days in advance of the date that the Contractor plans to perform the pressure tests. The Contractor will complete the required certification forms and submit them to the NTUA for approval. A copy of the approval or disapproval of the test results will be sent from the NTUA to the Contractor (see "Exhibit A & C of TP-4).

EXHIBIT A OF TP 4.0

WASTEWATER MAINLINE/MANHOLE WATER TEST 1 CERTIFICATION

LOCATION OF LINE TESTED: _____
Include Project's Name & Number

DATE(S) TEST WAS CONDUCTED: _____

STANDARD LENGTH OF PIPE IN TEST SECTION: _____ FEET.

THE TEST AND INFORMATION IS CERTIFIED BY:

Signature/Printed Name: _____

Organization/Address: _____

Address: _____

Telephone Number: _____

WASTEWATER TEST 1 RESULTS CHECKED AND APPROVED ON: _____
Date

BY: _____
NTUA Representative

PASSED _____ FAILED _____

COPY OF APPROVAL OF THE TEST SENT TO: _____
Project Agency Involved

ON _____ BY _____
Date NTUA

EXHIBIT B OF TP 4.0

WASTEWATER MAINLINE/MANHOLE WATER TEST 1-WORKSHEET

LOCATION OF LINE TESTED: _____

Include Project Name & Number

DATE(S) TEST WAS CONDUCTED: _____

(Allowable Leakage: 1 gal/section/2 hrs. for 8" PVC to 12" PVC, regardless of length, using 4-feet of head test pressure.)

SEWER MAIN

Sewer Main (MH# to MH#)	Size (in)	Length (ft.)	Actual Leakage (gal.)	Pass/Fail (P or F)	Remarks

Verified By: _____

NTUA Representative/Date

_____

Print Name/Title

(Allowable Ex-filtration: 5 gal./MH/2 hrs. regardless of height. Lamp testing shall be conducted at completion of final grading.)

SEWER MANHOLE

Manhole No.	Station	Actual Leakage (gal.)	Pass/Fail (P or F)	Remarks

Verified By: _____

NTUA Representative/Date

_____

Print Name/Title

EXHIBIT C OF TP 4.0

WASTEWATER MAINLINE/MANHOLE AIR/VACUUM TEST 2 CERTIFICATION

LOCATION OF LINE TESTED:_____
Include Project Name & Number

DATE(S) TEST WAS CONDUCTED: _____

THE GAUGE USED FOR TESTING SHALL HAVE MIN. DIVISION OF 0.10 PSI.

STANDARD LENGTH OF PIPE USED ON THIS PROJECT IS _____ FEET.

THE TEST AND ATTACHED INFORMATION IS CERTIFIED BY:

Signature/Printed Name: _____

Organization/Address: _____

Address: _____

Telephone Number: _____

WASTEWATER TEST 2 RESULTS CHECKED AND APPROVED ON: _____
Date

BY:_____
NTUA Representative

PASSED _____ FAILED _____

COPY OF APPROVAL OF THE TEST SENT TO: _____
Project Agency Involved

ON_____ BY_____
Date NTUA

EXHIBIT D OF TP 4.0

WASTEWATER MAINLINE/MANHOLE AIR/VACUUM TEST 2 WORKSHEET

LOCATION OF LINE TESTED: _____
Include Project's Name & Number

DATE(S) TEST WAS CONDUCTED: _____

Air testing shall be conducted between consecutive manholes. The test section shall be acceptable if the time required for the pressure to drop from 3.5 to 3.0 PSIG is greater than or equal to the time in the "Minimum Duration for Pressure Drop" table of TP-4.08.03.

SEWER MAIN AIR TEST

Sewer Main MH# to MH#	Size (in.)	Length (ft.)	Start Test Pressure (Psig)	Stop Test Pressure (Psig)	Elapsed Time (Min/Sec.)	Pass/Fail (P or F)	Remarks

Verified By: _____ Date: _____

Title/Company: _____

Manhole shall pass if time is greater than 60 seconds for 48" Dia. MH, 75 seconds for 60" Dia. MH, and 90 seconds for 72" Dia. MH.

MANHOLE VACUUM TEST

Manhole No.	Station	Start Vacuum of 10" of Mercury (Inch)	Stop Vacuum (Inch)	Elapsed Time (Min/Sec.)	Pass/Fail (P or F)	Remarks

Verified By: _____ Date: _____

Title/Company: _____

* Lamp test shall be conducted after completion of street construction and final grading.

TP 4.11 Individual Subsurface Disposal Systems (Not part of the Utility Company's Facilities)

4.11.01 General

The Contractor shall install individual subsurface disposal systems at the locations shown on the plans. The work shall consist of furnishing and installing a double compartment 1,000-gallon or larger septic tank, 4-inch sewer pipe, and leachfield system in accordance with these technical provisions and applicable drawings. All construction will be done in a workmanlike manner. All sites will be left with a neat appearance.

4.11.02 Septic Tanks

4.11.02.01 General

All septic tanks shall have a minimum liquid capacity of 1,000 gallons and double compartment. Liquid capacity shall be split with two-thirds in the first compartment and one-third in the second compartment. The liquid depth of the septic tanks shall be at least 4 feet but not more than 5 feet.

The inlet and outlet on all tanks shall be provided with vertical tee fittings of cast iron or PVC plastic. In concrete tanks, oval box shaped or slab type baffles of pre-cast reinforced concrete with a minimum thickness of 2-inches may be used. The inlet baffle or tee must penetrate at least 5-inches below the liquid level but in no case shall it be greater than the penetration of the outlet baffle or tee. Both inlet and outlet baffles or tees shall extend 6-inches or more above the liquid level and end 1-inch from the underside of the tank top to allow gases to escape. The outlet baffle or tee shall extend below liquid level 40 percent of the liquid depth for rectangular tanks and 35 percent for circular tanks. The common wall passage shall also be located at the 40 percent liquid level depth. The inlet invert should be at least 2-inches above the liquid level in the septic tank. Four copies of drawings indicating pertinent dimensions, type, and location of steel reinforcing in concrete tanks, and important details shall be submitted by the Contractor for approval by the Owner prior to the installation of any septic tank.

4.11.02.02 Concrete Tanks

Concrete septic tanks shall be of pre-cast, mechanically vibrated, 4,000 psi minimum strength, watertight concrete containing adequate steel reinforcement to facilitate handling. Minimum wall thickness shall be 3-inches. The top and bottom shall have a minimum

thickness of 4-inches. Minimum steel reinforcement will be No. 3 reinforcing bars spaced 2 feet on centers in both directions in the top, bottom, and sides. The equivalent shall be used around manhole inspection ports and construction joints. Minimum steel reinforcement of the access cover or lid shall be No. 4 rebars spaced 6-inches on center in both direction or equivalent. The manhole and inspection opening covers shall be provided with steel lifting handles of No. 3 or No. 4 rebar.

Tanks shall be free of cracks from casting or handling (including placement). No wire mesh or rebar shall be exposed at any point on the tank interior or exterior.

Adequate access shall be provided into the septic tank either through a removable section or manhole with a minimum of 20-inches in the least dimension. The access manhole may be placed partially over the inlet to serve as an inspection hole; otherwise, inspection openings with a minimum of 7inches in the least dimension shall be provided above the inlet, outlet, and the inter-compartment piping. The access manhole shall be provided with a 6-inch PVC coupling that extends through the center. A 6-inch diameter inspection pipe shall be installed so that it is connected to the access manhole coupling and extends to a point 12-inches above the ground surface. The pipe shall be 160 psi, SDR 26, PVC, shall terminate above ground surface with a 6-inch slip joint PVC cap, and shall be painted red on those portions above the ground surface.

4.11.03 Septic Tank Installation

Excavation shall be approximately 1 foot wider and longer than the tank. All tanks shall be set on a smooth level surface. The septic tank shall be placed plumb and true so that the inlet and outlet are at the highest possible elevations and so that the outlet pipe is not less than 2-inches nor more than 5-inches below the inlet pipe. The minimum bury for the septic tank inlet pipe shall be 18-inches. The maximum dirt cover for the septic tank shall be 36-inches. Where over excavation occurs, the bottom shall be raised to final elevation in 6-inch compacted lifts. Any water in the excavation must be removed and elevations checked before setting the tank. After setting the tank, it shall be filled with water to prevent floating. Both the septic tank inlet and outlet lines shall be grouted to the septic tank. Backfill around the tank shall be compacted and shall be sufficient to allow for no settlement.

4.11.04 Sewer Pipe and Fittings

All 4-inch pipe and fittings, except clean out tees, risers, hub adapters, and plugs, shall be PVC, SDR 35, solvent-weld joints and shall comply with ASTM

Specifications D-3033 and D-3034. All PVC shall be Type 1, Grade 1, PVC 1140 conforming to ASTM Specification D-1784.

Cleanout tees, risers, hub adapters, and plugs shall be PVC/DWV and comply with ASTM Specification D-2665.

4.11.05 Sewer Pipe Installation

All trenching, excavating, and backfilling shall be performed in accordance with TP 1.0 of these specifications. All construction shall provide a slope of 1/4" per foot (2%) and maintain at least 18-inches of cover over the line between the house and the septic tank. A minimum cover of 12-inches is required between the septic tank and drainfield system. Cleanout tees shall be two-way, 4" x 4" x 4", all solvent-weld hubs, PVC/DWV fittings. Cleanout risers for DWV cleanout shall be 4-inch PVC/DWV and shall terminate 3 to 6-inches above the ground surface with a PVC/DWV 4-inch hub adapter (solvent-weld hub by FIPT) and MIPT plug. Cleanout shall be placed at the house and at any in-line bends greater than 45 degree (bends greater than 45 degrees are discouraged) and at 100 feet intervals.

4.11.06 Drainfield Materials

4.11.06.01 Gravel

Drainfield gravel shall comply with the requirements for coarse aggregate under Federal Specification SS-A-281b, "Aggregate; (for) Portland-Cement-Concrete", and shall be Size 3 (2" to 1" nominal size). The amount of deleterious substances in the coarse aggregate shall not exceed the limits given in Section 3.2.3 of Federal Specification SS-A-281b.

4.11.06.02 Pipe and Fittings

All PVC shall be Type 1, Grade 1, PVC 1140 conforming to ASTM Specification D-1784. All 4-inch solid PVC pipe and fittings shall be PVC, SDR 35, solvent-weld joints and shall comply with ASTM Specifications D-3033 and D-3034. All 4-inch perforated PVC pipe shall be solvent-weld joints and shall comply with ASTM Specification D-2729 or D-3033 and D-3034. Perforations shall be ½ to 5/8 inch diameter holes on 5-inch centers in two rows spaced 90 to 120 degrees apart.

4.11.06.03 Drainage Fabric

The drainfield fabric shall be non-woven and composed of polypropylene filaments and shall be inert to biological degradation

and naturally encountered chemicals, alkalies, and acids. The fabric shall have a minimum average grab tensile strength of 120 pounds, a minimum average burst strength of 285 psi, a minimum average coefficient of permeability of 0.3 cm/sec, and a minimum thickness of 60 mils. The drainage fabric shall be equal to the Mirafi 140N non-woven fabric as manufactured by Mirafi, Inc., P.O. Box 240967, Charlotte, North Carolina.

4.11.07 Drainfield Installation

The trench width in the drainfield shall normally be 24-inches and shall not exceed 36-inches nor be less than 12-inches without the consent of the Owner. Trench bottoms shall be smooth and level from beginning of trench to end. All smeared or compacted surfaces of the trenches or bed shall be raked to expose the natural texture of the soil. All loose material shall be removed from the trench before the gravel is placed. The drainfield trench shall be kept as shallow as possible but with a minimum depth of 24-inches and a maximum depth of 60-inches. Drainfields shall be built so that all lines are looped. Where rock, clay, or ground water are encountered, the Contractor shall immediately notify the Owner and shall cease work on the drainfield installation. The bottom of the trench shall be covered with a 6-inch minimum depth lift of gravel. The lift shall be leveled (but not compacted) by hand to within $\pm$ 1-inch throughout the entire length of the trench. The 4-inch perforated plastic pipe shall then be laid level $\pm$ 1- inch by hand and centered in the trench. After the pipe has been laid, a second 6-inch lift of gravel shall be placed by hand and not compacted. The gravel shall be placed so that it extends 2-inches above the pipe. A layer of synthetic drainage fabric then shall be placed over the gravel and folded up the sides of the trench to prevent backfill soil from coming in contact with the gravel.

The trench shall then be backfilled and not compacted. The top shall then be mounded with a 8 to 12-inch crown and shall not be compacted. No mechanical or vehicular traffic shall be used to compact the trench. Backhoes shall not be allowed on trenches during or after the backfilling operation.

Four, red T-type, steel posts shall be placed at the outside corners of the drainfield. The post shall be driven a minimum of 14-inches into the ground and shall extend a minimum of 36-inches above the ground. The Contractor shall leave the premises in a neat and orderly condition. Excess dirt shall be spread evenly over the ground in the immediate area or disposed of in a manner approved by the Owner.

4.11.08 Gravel-less Drainfield Materials

The gravel-less drainfield shall consists of interlocking leaching chamber units, opened end plates, and closed end plates constructed from molded high density polyethylene. Gravel- less drainfield components shall be equal to the Infiltrator

as manufactured by Infiltrator Systems Inc., P.O. Box 768, Old Saybrook, CT 06475, or an approved equal.

4.11.09 Gravel-less Drainfield Installation

In place of perforated pipe and gravel for distribution and storage of waste water, leaching chambers or gravel-less drainfield systems can be employed.
The trench width for a gravel-less drainfield shall normally be 36-inches or as specified by the supplier of system. Trench bottoms shall be smooth and level from beginning of trench to end. All smeared or compacted surfaces of the trenches or bed shall be raked to expose the natural texture of the soil. All loose material shall be removed from the trench before the chamber units are installed. The trench shall be kept as shallow as possible but with a minimum depth of 24-inches and a maximum depth of 36-inches.

The installation of the gravel-less system shall be per the manufacturer's recommendations. Where rock, clay, or ground water are encountered, the Contractor shall immediately notify the Owner and shall cease work on the drainfield installation. The area between the leach chamber and trench wall shall be backfilled and compacted. The minimum cover for the gravel- less drainfield is 12-inches. The top shall then be mounded with an 8 to 12-inch crown and shall not be compacted. No mechanical or vehicular traffic shall be used to compact the trench. Backhoes shall not be allowed on trenches during or after the backfilling operation.

A 4-inch solid sewer PVC-DWV inspection port with adapter hub and plug shall be installed at the end of each line. The Contractor shall leave the premises in a neat and orderly condition. Excess dirt shall be spread evenly over the ground in the immediate area or disposed of in a manner approved by the Owner.

TECHNICAL PROVISIONS 5.0

TP 5.0 FINAL SITE UTILITY INSPECTION REQUIREMENTS

5.01 Final Inspection Package

The Contractor shall submit a complete site utility inspection package, which shall include the following items; all copies of which shall be legible.

5.01.01 As-Built Drawings

Four (4) sets of Size D "as-built" drawings which contain:

A. Cover Sheet
B. Rights of Way Plat Sheets
C. Utility Plan View Sheets
D. Water/Wastewater Plan and Profile Construction Sheets
E. Details Sheets - Standard and Specific Drawings

5.01.02 As-Built Notebook

Four (4) three ring, loose-leaf binders, containing the following information:

A. Water Pressure Test Certification and Test Results Approved by the NTUA. See "Exhibit A" of TP-3.
B. Wastewater Main and Manhole Test Certifications and Test Results Approved by the NTUA. See "Exhibit A" or "Exhibit C" of TP-4
C. Executed Transfer Agreement with Cost of Plant attached. See Exhibit "A" and "B" of TP-5.
D. Water Meter Serial Number Listing and Current Meter Readings.
E. Approved Tapping Permits.
F. Approved Water/Wastewater Material Submittals.
G. A set of plans on CD in the AutoCAD version specified.

5.02 Scheduling Final Inspection

The scheduling for the final inspection shall be coordinated with the NTUA by the Contractor. A complete as-built package is to be provided to the NTUA for review, a minimum of 21 calendar days prior to the scheduled inspection.

5.03 As-Built Drawing Requirements

Each project site that contains utilities to be transferred to the NTUA must be submitted with the following requirements and sheets.

5.03.01 General Requirements for All Sheets

5.03.01.01 Each sheet must be stamped by an A/E* and prominently labeled, signed, and dated by the Contractor (excepting cover and rights of way sheets):

AS BUILT _____
(Name) (Date)

"I certify that I have constructed this project following the standards set forth in TPs 1 - 4, and I have complied with all vertical and horizontal pipeline separation requirements."

5.03.01.02 All facilities shall be shown as constructed and references to "proposed" or "future" deleted.

5.03.01.03 Where appropriate, each sheet must have a north arrow. Whenever possible, the arrow shall be up or to the right of the sheet.

5.03.01.04 Where appropriate, each sheet must have a standard legend and bar scale. All existing mains must be solid lines and sewer manholes must be solid circles.

5.03.01.05 All sheets must be numbered sequentially beginning with "Sheet 1 of (Total) Sheets."

5.03.02 Cover Sheet

5.03.02.01 Since drawings occasionally cover several project sites, the location for each as-built site must be prominently identified by project number and project site location.

5.03.02.02 A map of the Navajo Nation that shows the project location, a vicinity map with a scale of 1" = 2 miles, and a north arrow is to be provided. These maps may be on a separate sheet or on the topographic boundary sheet.

5.03.02.03 The project site location, with the project number(s), should be shown on both the Navajo Nation and vicinity maps.

5.03.03 Plat Sheet

5.03.03.01 Show site boundaries with bearings and distances, complete with ties to permanent state plane markers (Section Corners, established monuments, etc.) and bearing references. All bearings shall be in the appropriate State Plane System in NAD 83 if possible; all distances shall be ground distances. Indicate basis of bearing.

5.03.03.02 Show and describe location of elevation and vertical datum references. A broken line may be utilized if the benchmark is not within the drawing scope or scale.

5.03.03.03 Show each lot and street boundary defined with bearings and distances, if appropriate. Show street centerline bearing, distance, and curve data.

5.03.03.04 Provide statements "Street Rights of Way are Dedicated to the Common Use of Utilities" if appropriate, and "the operating utility is not responsible for the repair or replacements of improvements in utility easements disturbed during operation and maintenance activities."

5.03.03.05 Show minimum 20-foot wide easements for each utility (electric, natural gas, water, sewers, telephones, cable) not located within the street right of way. Add an additional 10-foot width for each additional parallel utility. The NTUA will provide to the Contractor as-built drawings of utilities not constructed by the Contractor.

5.03.03.06 Utility or street rights of way may require expansion in localized areas to include all utility appurtenances (e.g., fire hydrant guards), which are not within the normal easement.

5.03.03.07 Provide a narrative legal description of the site boundary.

5.03.04 Utility Plan View Sheet(s)

5.03.04.01 On a sheet with a scale between 1"=20' and 1"=50', provide a plan view of the site that shows all utilities (e.g., propane, water, sewers, electric, natural gas, telephones, cable).

5.03.04.02 Show all lot, street, and easement boundary lines without bearing and distances.

5.03.04.03 Label all houses with final house numbers. Numbers must be

consistent with a swing tie table.

5.03.04.04 Provide a legend, north arrow, and bar scale.

5.03.04.05 Show as-built routing of all water and sewer mains and service lines. Emphasize water and sewer mains by using bolder lines. Use a smaller but bold line for service lines. Reference the standard NTUA legend.

5.03.04.06 Label water mains with size, type of material, pressure rating, and length of pipe from P.I. to P.I. Example: 6" PVC, SDR 21, 232.00'.

5.03.04.07 Label wastewater mains with size, type of material, and distances between manholes. Example: 8" PVC, SDR 35, 389.00'.

5.03.04.08 Label water and wastewater main tap points, to previous projects with previous project number and as-built sheet number. Contractor shall contact the Operating Utility to determine this information.

Examples:	White Cone Composite	Red Water Housing
	IHS NA 88-114	NHA AZ 12-106
	Sheet 15 of 43	Sheet C-8

5.03.04.09 Show and label depth of bury at all locations where water main varies from the standard depth of bury of 42 inches.

5.03.04.10 For fire hydrants, gate valves, tees, bends, water meters, curb stops, and saddles state the manufacturer model number and type of joint for the actual item used. As an option this information can be shown on the standard detail sheet next to the appropriate detail, or include submittals.

5.03.04.11 Show and label all water main fittings actually used. G.V., 6" DI TEE, 6" DI 45o BEND. Examples: 6” G.V., 6” DI TEE, 6” DI 45° BEND.

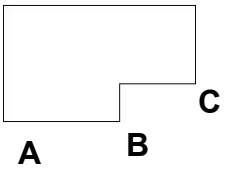
5.03.04.12 Provide swing ties in table format for all gate valves, water meters, domestic stops, curb stops, water main taps, manholes, main line clean out, yard clean outs, and sewer wyes. Swing ties shall be measured from building corners or other permanent structures.

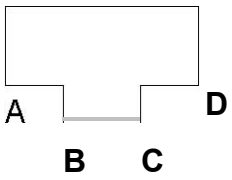
SWING TIES (Examples)

House No.	Domestic Stop		Water Meter		Curb Stop		Water Main Tap		Yard Clean out		Sewer Wye	
	A	B	A	B	A	B	A	C	A	B	A	C
1	31.6	3.8	34.8	32.9	36.7	35.8	42.0	65.0	22.4	11.6	57.0	73.0

Item	House No.		Distance
		A	B
MH 11A-3	3	56.2	68.4
		A	B
GV-1	5	43.4	63.6
		A	B
GV-2	5	43.6	61.6
		B	C
MH 11A-1-2	15	93.4	73.0
		B	C
CO-2	14	64.8	61.5

5.03.04.13 Label corners of each building or structure, as necessary, to provide references for swing tie tables.





5.03.04.14.1 Provide pipe information for each size and type of pipe in a table with the following format:

Use	Size (in)	Type of Material	Joint Type	SDR	Pressure Rating PSI	Dimensions (in)			ASTM No.
						O.D.	I.D.	Wall Thick	
Water	6	PVC	Slip	21	200	6.625	5.993	0.316	D2241
Water	1	PE	Stab	7	200	1.349	1.049	0.150	D2239

Sewer	8	PVC	Slip	35	N/A	8.400	7.920	0.240	D3034
Sewer	4	PVC	Slip	35	N/A	4.215	3.975	0.120	D3034

PIPE DIMENSIONAL DATA 5.03.05

5.03.05 Water/Wastewater Plan and Profile Sheet(s)

5.03.05.01 Plan View

Provide all items from the utility plan view sheet requirements on the Utility Plan View Sheets portion; TP 5.03.04.

5.03.05.02 Profile View

5.03.05.02.01 Label all manholes and wastewater main clean-outs with manholes and clean-out numbers. Provide rim elevations with inlet and outlet invert elevations. The manhole numbers must conform to the existing manhole numbering system. Station all manholes and connections.

5.03.05.02.02 Label all wastewater mains with size, type of material, slope, and distance. Distance shall be the actual distance of the pipeline. (O.D. of manholes to O.D. of manholes).

5.03.05.02.03 Show all water mains that cross the sewer main and dimension Pipe O.D. to Pipe O.D. the vertical separation. Station all water mains and appurtenances.

EXHIBIT A OF TP 5.0

Note: (This is an example only. The actual Cost of Plant shall be developed by the Contractor and attached to the Transfer Agreement.)

COST OF PLANT

NHA Project AZ 12-51
Kayenta, Arizona

ITEM	QUANTITY	UNIT	LABOR	MATERIAL	TRANS.	TOTAL
8" PVC Sewer Main	1745	LF	$7,187.22	$5,750.00	$1,437.44	$14,374.66
Precast Manhole	7	EA.	$2,101.10	$1,681.68	$ 420.00	$ 4,209.78
8" Sewer Clean out	1	EA.	$ 123.50	$ 68.75	$ 24.75	$ 216.50
Sewer Service Connection	30	EA.	$2,415.00	$1,932.00	$ 483.00	$ 4,830.00
					Subtotal:	$23,630.94
6" PVC Water Main	1707	LF	$16,438.41	$13,150.73	$3,287.68	$32,876.82
Fire Hydrant	3	EA.	$ 750.00	$ 600.00	$ 150.00	$ 1,500.00
6" Gate Valves	9	EA.	$ 948.47	$ 758.00	$ 189.00	$ 1,895.47
1" Water Service Line w/Meters	30	EA.	$ 6,420.00	$ 5,136.00	$1,284.00	$12,840.00
					Subtotal:	$49,112.29
TOTAL COST OF UTILITY PLANT:						**$72,743.23**
Less: Sewer Service Connection not transferred to Operating Utility:						-$ 4,830.00
					TOTAL OF PLANT TRANSFERRED:	**$67,913.23**

EXHIBIT B OF TP 5.0

UTILITY TRANSFER AGREEMENT
FOR
WATER AND WASTEWATER FACILITIES

This agreement is made between _____, hereinafter called the Grantor, and the **NAVAJO TRIBAL UTILITY AUTHORITY,** hereinafter, call the Grantee.

WHEREAS, the Grantor has constructed or caused to have constructed water and wastewater facilities located at or near_____ _____ as shown on the plans titled_____ _____, designed by _____, and dated _____ and said facilities and related final as-built plans already have been inspected, accepted and approved by the Grantee, and;

WHEREAS, the Grantor wishes to convey to the Grantee all his interest in these facilities and appurtenances constructed at the above-mentioned location on or about the above-mentioned time, along with all rights, rights of way, and privileges so that the Grantee may own, operate, and maintain all such facilities and appurtenances.

NOW THEREFORE IT IS AGREED:

For consideration of $1.00, the receipt of which already has been acknowledged, the Grantor transfers, assigns, grants, and conveys to the Grantee all rights, titles, interests, easements, and rights of way in the aforementioned facilities, and;

The Grantee agrees to accept such aforementioned facilities, and further agrees to own, operate, and maintain such facilities in a reasonable and prudent manner until such facilities are determined to be no longer of any value. Further, the Grantor hereby warranties all such facilities against defects in workmanship and materials, and for design deficiencies, errors, and omissions for the period of one year beginning on _____and ending on _____.

A listing of the total inventory and Cost of Plant determined by the Grantor, to be transferred to the Grantee, is attached as EXHIBIT ____ and made a part of this Utility Transfer Agreement. The total Cost of Plant as appears on this document is $_____.

IN WITNESS THEREOF, both parties have signed and dated this agreement.

Grantor: by _____ Date: _____
Signature

_____
Printed Name

Navajo Tribal Utility Authority: by _____ Date: _____
Signature

_____
Printed Name

SECTION 33 4100

STORM UTILITY DRAINAGE PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Pipe and fittings.
2. Catch basins.

1.2 DEFINITIONS

A. PE: Polyethylene plastic.

B. PVC: Polyvinyl chloride plastic.

1.3 PERFORMANCE REQUIREMENTS

A. Gravity-Flow, Nonpressure, Drainage-Piping Pressure Rating: 10-foot head of water. Pipe joints shall have at least a watertight joint, unless otherwise indicated.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings:

1. Catch basins. Include plans, elevations, sections, details, frames, covers, and grates.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Show pipe sizes, locations, and elevations. Show other piping in same trench and clearances from storm drainage system piping. Indicate interface and spatial relationship between piping and proximate structures.

B. Profile Drawings: Show system piping in elevation. Draw profiles at horizontal scale of not less than 1 inch equals 50 feet (1:500) and vertical scale of not less than 1 inch equals 5 feet (1:50). Indicate catch basins and piping. Show types, sizes, materials, and elevations of other utilities crossing system piping.

C. Product Certificates: For each type of pipe and fitting, from manufacturer.

D. Field quality-control reports.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Do not store plastic pipe and fittings in direct sunlight.

B. Protect pipe, pipe fittings, and seals from dirt and damage.

C. Protect and handle catch basins according to manufacturer's written instructions.

PART 2 - PRODUCTS

2.1 PE PIPE AND FITTINGS

A. Corrugated PE Drainage Pipe and Fittings NPS 3 to NPS 10: AASHTO M 252, Type S, with watertight joints.

1. Watertight Joints: ASTM D3212.
2. Gaskets: ASTM F477.

B. Corrugated PE Pipe and Fittings NPS 12 to NPS 60: AASHTO M 294, Type S, or ASTM F2306 with watertight joints.

1. Watertight Joints: ASTM D3212.
2. Gaskets: ASTM F477.

2.2 CATCH BASINS

A. Standard Catch Basins: ASTM D1784 cell class 12454, PVC, of depth indicated, with

1. Size: As indicated.
2. Joint Tightness: ASTM D3212.
3. Flexible Elastomeric Seal: ASTM F477.

B. Frames and Grates: ASTM A 536, Grade 70-50-05, ductile iron.
1. Size: As indicated.

C. Manufacturer:
1. Drain Basin with frame and grate, as manufactured by Nyloplast, or approved equal.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Excavation, trenching, and backfilling are specified in Section 312000 “Earth Moving.”

3.2 PIPING INSTALLATION

A. General Locations and Arrangements: Drawing plans and details indicate general location and arrangement of underground storm drainage piping. Location and arrangement of piping layout take design considerations into account. Install piping as indicated, to extent practical. Where specific installation is not indicated, follow piping manufacturer's written instructions.

B. Install piping beginning at low point, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements.

C. Install proper size increasers, reducers, and couplings where different sizes or materials of pipes and fittings are connected. Reducing size of piping in direction of flow is prohibited.

D. Install gravity-flow, nonpressure drainage piping according to the following:
1. Install piping pitched down in direction of flow, at minimum slope of 0.5 percent, unless otherwise indicated.
2. Install piping with 12-inch minimum cover.
3. Install PE corrugated sewer piping according to CPPA's "Recommended Installation Practices for Corrugated Polyethylene Pipe and Fittings."

3.3 CATCH BASIN INSTALLATION

A. Install catch basins to sizes and shapes indicated and follow manufacturer’s written instructions.

B. Set frames and grates to elevations indicated.

3.4 FIELD QUALITY CONTROL

A. Inspect interior of piping to determine whether line displacement or other damage has occurred. Inspect after approximately 24 inches of backfill is in place, and again at completion of Project.
1. Submit separate reports for each system inspection.
2. Defects requiring correction include the following:
a. Alignment: Less than full diameter of inside of pipe is visible between structures.
b. Deflection: Flexible piping with deflection that prevents passage of ball or cylinder of size not less than 92.5 percent of piping diameter.
c. Crushed, broken, cracked, or otherwise damaged piping.
d. Infiltration: Water leakage into piping.
e. Exfiltration: Water leakage from or around piping.
3. Replace defective piping using new materials, and repeat inspections until defects are within allowances specified.
4. Reinspect and repeat procedure until results are satisfactory.

B. Test new piping systems, and parts of existing systems that have been altered, extended, or repaired, for leaks and defects.

1. Do not enclose, cover, or put into service before inspection and approval.
2. Test completed piping systems according to authorities having jurisdiction.
3. Schedule tests and inspections by authorities having jurisdiction with at least 24 hours' advance notice.
4. Submit separate report for each test.
5. Gravity-Flow Storm Drainage Piping: Test according to requirements of authorities having jurisdiction.

C. Test watertightness in accordance with ASTM F2487 by field performance verification.

D. Leaks and loss in test pressure constitute defects that must be repaired.

E. Replace leaking piping using new materials, and repeat testing until leakage is within allowances specified.

3.5 CLEANING

A. Clean interior of piping of dirt and superfluous materials.

END OF SECTION

SECTION 33 4213 - PIPE CULVERTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Pipe culverts.
   2. Joints and accessories.
   3. Bedding.
   4. Slope protection at pipe end.

B. Related Sections:
   1. Section 312000 – Earth Moving: Excavating and backfilling for culvert piping.
   2. Section 313700 – Riprap: Erosion protection at culvert ends.

1.2 REFERENCES

A. American Association of State Highway and Transportation Officials:
   1. AASHTO M36 – Corrugated Steel Pipe, Metallic Coated, for Sewers and Drains.
   2. AASHTO M190 – Bituminous-Coated Corrugated Metal Culvert Pipe and Pipe Arches.
   3. AASHTO M196 – Corrugated Aluminum Pipe for Sewers and Drains.
   4. AASHTO M294 - Specification for Corrugated Polyethylene Pipe, 305- to 915- mm (12- to 36-In.) Diameter.
   5. AASHTO M294 - Corrugated Polyethylene Pipe

B. ASTM International:
   1. ASTM A929 - Standard Specification for Steel Sheet, Metallic-Coated by the HotDip Process for Corrugated Steel Pipe.
   2. ASTM C14 - Standard Specification for Concrete Sewer, Storm Drain, and Culvert Pipe.
   3. ASTM C76 - Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe.
   4. ASTM C443 - Standard Specification for Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets.
   5. ASTM C506 - Standard Specification for Reinforced Concrete Arch Culvert, Storm Drain, and Sewer Pipe.
   6. ASTM C507 - Standard Specification for Reinforced Concrete Elliptical Culvert, Storm Drain, and Sewer Pipe.
   7. ASTM D2321 - Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications.
   8. ASTM D3034 - Standard Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
   9. ASTM F477 - Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.

C. Standard Specifications:
   1. Standard Specifications for Construction of Roads and Bridges on Federal Highway Projects FP-14.

1.3 SUBMITTALS

A. Product Data: Submit data on pipe, fittings and accessories.

B. Manufacturer's Installation Instructions: Submit special procedures required to install Products specified.

1.4 CLOSEOUT SUBMITTALS

A. Project Record Documents:
   1. Accurately record actual locations of pipe runs, connections, and invert elevations.
   2. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

B. Operation and Maintenance Data: Procedures for submittals.

PART 2 - PRODUCTS

2.1 STORM DRAINAGE PIPING

A. Reinforced Concrete Pipe (RCP): ASTM C76, bell and spigot or tongue and groove ends.
   1. Pipe Class: Class III with Wall Type B, unless otherwise shown on Drawings.
   2. Fittings: Reinforced concrete.
   3. Joints: ASTM C443, rubber compression gasket.

B. HDPE Pipe and Fittings:
   1. Conform to Section 33 4100.

C. Corrugated Metal Pipe (CMP):
   1. Steel Pipe: AASHTO M36, Gage 16 for 6” through 48”, Gage 14 for 54”, Gage 12 for 60”.
   2. Fittings: Corrugated Steel or Aluminum to match pipe.
   3. Joints: Corrugated coupling bands, galvanized steel or aluminum to match pipe, minimum 10 inches wide; connected with two neoprene "O" ring gaskets per and two galvanized steel bolts.

D. Bituminous Coated CMP: AASHTO M 190, Coated inside and out with 0.050 inch thick bituminous coating.

E. Slotted Drain Grates
   1. The grates shall be manufactured from ASTM A1011, Grade 36 steel. The spacers and bearing bars (sides) shall be 3/16" material ± 0.008".
   2. The spacers shall be on 6" centers and welded on both sides to each bearing bar (sides) with four (4) 1-1/4" long 3/16" fillet welds on each side of the bearing bar.
   3. Vertical (straight sides) grate with a 1-3/4" opening in the top and vertical spacers unless shown otherwise on the plans. The grate shall be 2-1/2" or 6" high as shown on the plans.
   4. The engineer may call for tensile strength tests on the grate if the grate is not in compliance with Section 2.1(E)(2). If tensile strength tests are called for, minimum results for an in-place spacer pulled perpendicular to the bearing bar shall be:
      T = 12,000 pounds for 2-1/2" grate
      T = 15,000 pounds for 6" grate
   5. The grate shall be fillet welded with a minimum weld 1" long to the CSP on each side of the grate at every other corrugation.
   6. Variable height grates shall be used to achieve the slope shown on the plans.
   7. When side plate extender are utilized, they shall be 7 gage steel meeting ASTM A761 with minimum yield / tensile strengths of 28,000 and 42,000 respectively.

2.2 BEDDING AND COVER MATERIALS

A. General: Conform to Section 312000 for bedding and backfill around and on top of pipe.
B. Bedding for Rigid Pipe (RCP): Clean sand, slightly silty sand, or slightly clayey sand having a Unified Soil Classification of SP, SP-SM or SP-SC.

C. Bedding for Flexible Pipe (HDPE and CMP): Clean course aggregate Gradation No. 57 conforming to FP-14 Standard Specifications.

D. Cover and Fill: Conform to Section 312000.

2.3 ACCESSORIES

A. Geotextile Fabric: Conform to Section 312000.

B. Concrete: Concrete conforming to Section 725 of MAG's Uniform Standard Specifications and Details for Public Works Construction.

1. Compressive strength of 3,000 psi at 28 days.
2. Air entrained.
3. Water cement ratio of 0.488 with rounded aggregate and 0.532 with angular aggregate.
4. Maximum slump of 3.5 inch for vibrated concrete and 4 inch for non-vibrated concrete.
5. Minimum cement content of 564 pounds per cubic yard for vibrated concrete and 602 pounds per cubic yard for non-vibrated concrete.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Section 013000 - Administrative Requirements: Verification of existing conditions before starting work.

B. Verify trench cut is ready to receive work and excavations, dimensions, and elevations are as indicated on Drawings.

3.2 PREPARATION

A. Remove large stones or other hard matter which could damage piping or impede consistent backfilling or compaction.

3.3 EXCAVATION AND BEDDING

A. Excavate pipe trench in accordance with Section 312000.

B. Excavate to lines and grades shown on Drawings or required to accommodate installation of encasement.

C. Dewater excavations to maintain dry conditions and preserve final grades at bottom of excavation.

D. Place bedding material at trench bottom, level continuous layer not exceeding 8-inch compacted depth; compact to 95 percent per Section 312000.

E. Maintain optimum moisture content of bedding material to attain required compaction density.

3.4 INSTALLATION – PIPE

A. Install in accordance with manufactures instructions and as indicated on Drawings.

B. Install plastic pipe, fittings, and accessories in accordance with ASTM D2321.

C. Seal joints watertight.

D. Begin at downstream end and progress upstream.

E. Keep pipe and fittings clean until work is completed and accepted by Engineer.

F. Lay bell and spigot pipe with bells upstream.

G. Repair surface damage to pipe with protective coating with two coats of compatible bituminous paint coating.

H. Install cover at sides and over top of pipe

3.5 PIPE ENDS

A. Place fill at pipe ends to match embankment slopes, concrete aprons, adjacent construction, end sections, or end walls as indicated on Drawings.

3.6 ERECTION TOLERANCES

A. Section 014000 - Quality Requirements: Tolerances.

B. Lay pipe to alignment and slope gradients noted on Drawings; with maximum variation from indicated slope of 1/8 inch in 10 feet.

C. Maximum Variation from Intended Elevation of Culvert Invert: 1/2 inch.

D. Maximum Offset of Pipe From Indicated Alignment: 1 inch.

E. Maximum Variation in Profile of Structure from Intended Position: 1 percent.

3.7 FIELD QUALITY CONTROL

A. Section 014000 - Quality Requirements: Field inspecting, testing, adjusting, and balancing.

B. Request inspection prior to and immediately after placing bedding.

C. Soil Compaction Testing: In accordance with Section 312000.

D. When tests indicate Work does not meet specified requirements, remove work, replace, and retest.

3.8 PROTECTION OF INSTALLED CONSTRUCTION

A. Section 017000 - Execution and Closeout Requirements: Protecting installed construction.

B. Protect pipe and bedding from damage or displacement until backfilling operation is in progress.

END OF SECTION

SECTION 34 400
TRANSPORATION SIGNALING AND CONTROL EQUIPMENT

(BASIS OF DESIGN)

TAPCO®
Safe travels.™

Solar Powered LED Warning Device

Emergency Vehicle Warning System

Specification Guide

Primary Function:

The primary function of the TAPCO Emergency Vehicle Warning System (EVWS) is to provide a high-visibility advance warning to road users of emergency vehicles about to either enter or exit the roadway in front of an Emergency Vehicle Facility. The EVWS advance warning LED indicators can be triggered wirelessly either from inside the emergency vehicle station via a pushbutton or directly from an emergency vehicle equipped with an Opticom™ preemption transmitter.

Description of Components:

The Manufacturer shall provide components for solar-powered BlinkerSign® or BlinkerBeacon® LED Assemblies which may be activated wirelessly by either an Opticom™ compatible sensor located outside the Emergency Vehicle facility or a push button located inside the Emergency Vehicle facility.

Components include:

BlinkerSigns or BlinkerBeacons, Solar panels and Control Cabinets containing the 900 MHz FHSS Wireless transceiver with Integrated Flash and Solar Controller, and Battery along with all mounting brackets. For activation, either:

- Push Button cabinet containing a Flash Controller with 900MHz FHSS wireless transceiver with remote antenna and cable to be installed and plugged into a 120VAC outlet inside the Emergency Vehicle facility in a convenient location. Omnidirectional Antenna mounted outside
- An OpticomTM compatible sensor with solar panel and control cabinet containing a solar charge controller, battery and Flash Controller with integrated wireless transceiver. This is to be mounted outside the Emergency Vehicle facility.

General Requirements:

The BlinkerSign Manufacturer shall have a minimum of ten years of relevant intelligent traffic product manufacturing experience, as well as a minimum of ten years of BlinkerSign manufacturing experience.

Specific Functional and Electrical Hardware Requirements:

System

- Each Emergency Vehicle Warning System shall consist of the following assemblies:
  - Two Solar Warning BlinkerSign® assemblies with solar panel, battery and flash controller
    OR

- A single or dual BlinkerBeacon® with separate pole mounted Control Cabinet and solar panel

- A pushbutton activation cabinet with 120VAC power cord, antenna cable and Omnidirectional antenna
  OR
- An Opticom™ compatible sensor with separate pole mounted Control Cabinet and solar panel

- Upon activation by either a pushbutton activation assembly mounted inside the emergency facility or the Opticom™ compatible sensor, all the system Emergency Vehicle Warning BlinkerSigns or BlinkerBeacons will be activated. Activation is accomplished through the use of frequency hopping spread spectrum (FHSS) 900 MHz wireless transceivers to minimize the effects of RF interference.
- When activated, all LED warning indicators associated with the system shall simultaneously commence operation within 120 milliseconds, and shall cease operation either manually with another button press or automatically with expiration of the activation timer.
- Emergency Vehicle Warning System components that are installed outdoors shall operate on solar charged battery power.
- The push button activation assembly that is installed inside the emergency facility shall operate via plug in 120VAC power.

Activation Control Cabinets

Push Button Activation Cabinet

- Contains a 900 MHz wireless transceiver integrated with the Programmable Flash Controller for Emergency Vehicle Warning System communications.
- Activation shall be performed with the press of an ADA compliant pushbutton that is installed on the face of the IP67 rated polycarbonate cabinet.
- Shall have an external connection to accommodate remote mounting of Omnidirectional antenna for 900 MHz FHSS wireless transceiver communications
- Shall include Omnidirectional External Antenna and mounting bracket along with sufficient antenna cable for remote antenna mount on exterior of emergency facility.
- Two LED indicators shall be mounted on the door of the cabinet to indicate power and activation status.
- Shall be desktop or wall mountable.
- Shall be powered via a power cord with a grounded plug, to be connected to facility's 120 VAC power source.

Opticom™ Compatible Sensor Activation Cabinet

- Shall contain the Flash Controller with integrated 900MHz FHSS Wireless Transceiver for Emergency Vehicle Warning System communications, along with the Solar Charge Controller, 35Ah Battery and Terminal Block with landing points for the 30W Solar Panel, Opticom compatible Sensor and Battery.

- Shall be NEMA 3R Type
- Shall be 15.0” tall x 12.5” wide x 9.9” deep and constructed of minimum 0.080" thick aluminum.
- To promote airflow for internal components, the cabinet shall be vented with screening included on all vents and drains to prevent insects and other foreign matter from entering.
- For security, the cabinet must include at least two tamper-resistant stainless steel hinges and a replaceable #2 traffic lock with keys.
- To facilitate maintenance or repairs, the cabinet shall include a removable control panel to which all control circuit components either mount or connect.
- For easy installation on a wide range of pole sizes and types, the cabinet shall utilize four 5/16"-18 stainless steel mounting studs that mate to a range of bracket options. To ensure a secure mount to the supporting post, two banding style brackets that fit poles with a 2-3/8” or larger diameter shall be included as standard equipment. Mounting brackets also available for square pole, wooden post, and wall mount applications.
- To prevent corrosion, all materials used in the construction or mounting of the control cabinet shall be either aluminum or stainless steel. Anti-vandal mounting hardware shall be available as an option.
- A UV resistant label shall be applied to the exterior of the cabinet and include system specific information including model number, serial number, date of manufacture, as well as any applicable regulatory compliance information.

Solar Warning BlinkerSign Assembly

A single assembly that includes a LED enhanced Warning BlinkerSign, BlinkerSign Control Circuit with integrated solar charge regulator and FHSS 900 MHz wireless transceiver, battery, mounted solar panel and optional mounting hardware.

BlinkerSign® LED Sign

- All signs shall conform to 2009 Federal Highway Administration’s MUTCD section 2A.07 on retro reflectivity and illumination. Each sign shall have a quantity of Day-Viz® Daylight-Visible LEDs that are embedded individually into 1" diameter holes around the perimeter of the sign and shall be ultrasonically welded to the sign assembly to provide maximum strength and rigidity. Each sign blank material shall be a minimum of 0.080" thick aluminum.
- Each sign face shall consist of 3M™ Diamond Grade™ DG3 reflective sheeting, colored per the requirements, for MUTCD compliance. This sheeting shall be applied to the sign blank with a 3M™ 1160 Premium Protective Overlay film, if required, to provide an additional layer of graffiti protection.
- Shall be an MUTCD compliant Sign legend, sized per the requirements.
- Shall consist of eight quantity high power, 1 watt Amber LEDs with a viewing angle of 15°.
- Shall have each LED sealed within a 7/8" diameter, heat-dissipating plastic enclosure to provide resistance to weather and vibration.

- Shall have the LEDs wired in strings to activate simultaneously per MUTCD standards.
- Shall have the LEDs wired in parallel electrically so that remaining LEDs continue to flash in the event of the failure of any individual LED.
- Wiring between BlinkerSign LEDs shall be encapsulated inside 1" x 3/8" aluminum extrusions secured to the back of each sign assembly, to provide weather resistance and protection.
- Each sign shall have two holes for mounting to a pole or post. Optional vandal-resistant fasteners to mount the BlinkerSign LED sign assembly to a pole or post shall be available.
- UV-resistant label(s) shall be applied to the back of each sign assembly and shall include specific information such as the manufacturer, manufacturer phone number, model number, serial number, date of manufacture and any applicable regulatory compliance information.

BlinkerSign® Control Circuit

Consists of an integrated Programmable Flash Controller and Solar Charge Regulator, and shall:

- Have the capability of RS2323 communications for programming with Windows based software.
- Include integrated constant-current LED drivers with a minimum of two-channel output for driving one or two BlinkerSign units
- Flash the BlinkerSign LEDs 50 to 60 flashes per minute
- Provide 6 levels of BlinkerSign® LED brightness through LED drive current control as determined by the solar panel charge input
- Shall Run for a programmable time period when activated through a wireless transceiver from an external sensor such as a Tomar STROBESWITCH™ Emergency Vehicle Access receiver or a pushbutton
- Automatically adjust the BlinkerSign LED drive current control to optimize brightness for the ambient lighting conditions
- Have a fully programmable AutoBright™ charging and load control algorithm that is adjustable for user specific applications:
    - Autonomous adjustable duty cycle up to 100%
    - Autonomous adjustable brightness
- Have the BlinkerSign LED drive outputs reach the full output current as programmed within the duration of the 100ms on-time
- Manage the battery charge and BlinkerSign LED brightness levels and duty cycle in order to maximize the number of days of continuous use without any solar charging
- Be capable of solar charging a completely drained battery pack
- Operate between the temperatures of -40° to +176°F (-40° to +80°C)

900 MHz FHSS Wireless Transceiver

- Shall be housed inside the IP67 rated Flash Controller Cabinet
- Shall seamlessly integrate with any of the system controllers to ensure sequential activation of other radio-equipped devices in the system
- Shall include an integrated LCD and two user-interface buttons for setup and troubleshooting, including readouts of flash duration (timeout), battery conditions, and LED testing functionality
- Shall include two LED indicators for status and troubleshooting
- Shall be capable of operating as a Parent (Gateway) or Child (Node or Repeater)
- Shall be capable of providing site-survey data for verification of signal strength between network devices
- Shall include network-wide modification of sign controller settings and output durations, using programmability from any networked transceiver without the use of additional equipment or software
- Shall synchronize the system components to activate the indications within 120msec of one other and remain synchronized throughout the duration of the flash (timeout) cycle.
- Shall have an antenna connector for easily connecting to multiple antenna options
- Shall operate on the license-free ISM band
- Shall comply with part 15 of FCC rules
- Shall operate from 3.3VDC to 15VDC
- Shall be, in the unlikely event of failure, replaceable independently of other components.

Solar BlinkerSign Battery Power

The Battery pack shall:

- Shall be Nickel Metal Hydride (NiMH)
- Have a nominal output voltage of 4.8VDC and a capacity of 14Ah
- Be dimensioned to fit inside the 2-3/8" Aluminum Solar Panel Support Tube
- Be sealed in a plastic film to provide resistance to moisture and corrosion.
- Have fusing between each cell and shall be protected from overheating by means of a thermocouple sensor.
- Operate between the temperatures of -4° to +140°F (-20° to + 60°C)
- Be replaceable independently of other components.

BlinkerSign Solar Panel

The solar panel shall:

- Be 14" x 15.5" in size
- Be constructed of an anodized aluminum frame, high-transmission 1/8" tempered glass, with silicon cells encapsulated in double-layer EVA, and with a white polymer backing.

- Shall securely mount to an aluminum plate and pole top bracket at a fixed angle of 45° to provide maximum insolation exposure*. To ensure maximum solar insolation regardless of installation location, the post top mounting system shall provide 360° of rotational direction adjustment.

  *Note that the solar panel must be oriented with Collector facing south.

  The pole top bracket shall be secured to a 2-3/8" aluminum supporting tube with stainless steel fasteners that allow rotational solar panel adjustment. The solar panel supporting tube also holds the battery pack and the BlinkerSign Control Circuit, which is potted in a waterproof, cylindrical epoxy resin housing. The complete assembly is secured to the back of the sign utilizing aluminum brackets that are attached to the ultrasonically welded studs with vandal-resistant hardware.
- Be IEC61215, TUV, and UL 1703 certified.
- Operate at 6VDC nominal with a maximum output rating of 13.5W.
- Include an IP65 rated junction box with terminals sized for 8-16AWG wire.
- Be constructed of an anodized aluminum frame, high-transmission 1/8" tempered glass, with silicon cells encapsulated in double-layer EVA, and with a white polymer backing.
- Be affixed to an aluminum plate and bracket, adjustable at an angle of 45°- 60° to facilitate adjustment for maximum solar collection to optimize battery charging.
- Be attached to a panel, plate and bracket to facilitate mounting and adjustment for maximum solar collection and optimal battery strength.
- Have a maximum power voltage 9.1V
- Have a maximum power current 1.49A
- Have a short circuit current 1.52A
- Have an open circuit voltage 11.0V
- Operate from -40° to +194°F (-40° to +90°C)

Wiring and Connectors

- All LED connectors shall conform to Ingress Protection, IP-67 rating, dust proof and protected from temporary immersion in water up to 1 meter deep for 30 minutes.
- Connectors shall be Deutsch DTM series.
- All wire used shall conform to military specifications, MIL-W-16878D, Type D, vinyl nylon jacket.

Solar Warning BlinkerBeacon® Assemblies

Includes either one or two LED BlinkerBeacons as required, 30W Solar Panel, Control Cabinet with Solar Charge Controller, 35Ah Battery and Flash Controller with integrated FHSS 900 MHz wireless transceiver.

- **LED BlinkerBeacon Warning Assemblies**

- Each warning beacon assembly shall consist of:
  - A yellow polycarbonate vehicle traffic signal housing
  - A black polycarbonate door
  - A black poly visor
  - A 12" amber LED beacon module
  - An aluminum mounting arm with yellow powder coat finish.
- The signal housing shall be a one-piece unit with serrations in 5° increments at each end to allow for positive positioning during mounting and include provisions for attaching back plates if required (Optional Back plates available).
- The housing, door and visor shall be injection molded of ultraviolet stabilized, pre-colored opaque polycarbonate.
- To prevent water entry, a neoprene gasket shall be included between the door and housing.
- A black cut visor shall be included as standard equipment, with other colors and styles available as options.
- To prevent any marring of the finished surface, the arm assembly shall be assembled prior to powder coat application with all internal threads completely masked to prevent paint build-up.
- To prevent corrosion, all materials used in the construction and mounting of the beacon assembly shall be either polycarbonate, powder coated aluminum, aluminum, or stainless steel.
- The beacon assembly will be provided with the bracketry and hardware necessary for mast arm mounting per the requirements.
- The LED beacon module shall provide incandescent-like appearance, be a fully sealed module featuring robust high flux LED technology, include abrasion resistant lens coating and easily install into existing signal enclosures if needed. The LED beacon module shall come pre-installed in the beacon assembly.
- The 12" Amber LED Beacon module shall at a minimum:
  - Utilize Dialight's LED Robust High Flux LED Technology
  - Be driven directly from the constant current DC output of the programmable Flash Controller
  - Include a yellow power wire and white ground wire quick connect spade terminals
  - Meet or exceed Military Standard 883, test method 2007 for vibration resistance
  - Meet or exceed Military Standard 810F, test method 506.4 for moisture resistance to rain and blowing rain
  - Have a dominant wavelength of 590nm (Amber)
  - Operate from -40° to +165°F (-40° to +74°C)

- **BlinkerBeacon Control Cabinet**

  - Shall be NEMA 3R Type

- Shall be 15.0” tall x 12.5” wide x 9.9” deep and constructed of minimum 0.080" thick aluminum.
- To promote airflow for internal components, the cabinet shall be vented with screening included on all vents and drains to prevent insects and other foreign matter from entering.
- For security, the cabinet must include at least two tamper-resistant stainless steel hinges and a replaceable #2 traffic lock with keys.
- To facilitate maintenance or repairs, the cabinet shall include a removable control panel to which all control circuit components either mount or connect.
- For easy installation on a wide range of pole sizes and types, the cabinet shall utilize four 5/16"-18 stainless steel mounting studs that mate to a range of bracket options. To ensure a secure mount to the supporting post, two banding style brackets that fit poles with a 2-3/8” or larger diameter shall be included as standard equipment. Mounting brackets also available for square pole, wooden post, and wall mount applications.
- To prevent corrosion, all materials used in the construction or mounting of the control cabinet shall be either aluminum or stainless steel. Anti-vandal mounting hardware shall be available as an option.
- A UV resistant label shall be applied to the exterior of the cabinet and include system specific information including model number, serial number, date of manufacture, as well as any applicable regulatory compliance information.

Solar charged, battery powered Opticom™ Compatible Activation Components

Opticom Compatible Sensor

- Shall be the Strobeswitch™ manufactured by Tomar
- Shall be compatible with optical signals from all Tomar Strobecom and Opticom emitters
- Shall have a typical sensing range of 200 feet
- Shall have a 60° conical field of view
- Shall have a signal acquisition time of 1.5 seconds
- Shall have an internal LED indicator when an optical signal is registered for test
- Shall operate at 12VDC
- Shall operate at an idle current of 4mA typical
- Shall have a solid-state relay output
- Shall be provided with all necessary mounting hardware and wiring

35Ah Battery

- Shall consist of three quantity 35Ah batteries connected electrically in parallel that have a nominal output voltage of 12VDC and a total capacity of 105Ah at a C/100 discharge rate

- Shall be valve regulated, AGM type
- Shall be sealed and spill proof
- Shall have terminals that accept screw or bolts for secure wiring connections.
- Shall be replaceable independently of other components.
- Shall be fused for short circuit protection

30W Solar Panel

The solar panel provided for each pole shall:

- Be IEC61215, TUV, and UL 1703 certified.
- Operate at 12VDC nominal
- Include an IP65 rated junction box with terminals sized for 8-16AWG wire.
- Be constructed of an anodized aluminum frame, high-transmission 1/8" tempered glass, with silicon cells encapsulated in double-layer EVA, and with a white polymer backing.
- Be affixed to an aluminum plate and bracket, adjustable at an angle of 45°- 60° to facilitate adjustment for maximum solar collection to optimize battery charging.
- Be attached to a panel, plate and bracket to facilitate mounting and adjustment for maximum solar collection and optimal battery strength.
- Operate from -40° to +194°F (-40° to +90°C)
- Include mounting bracket and hardware for mounting to the support pole.
- Have a maximum output rating of 30W
- Have an overall size of 26” x 16”
- Have a maximum power voltage 17.3V
- Have a maximum power current 1.77A
- Have a short circuit current 1.93A
- Have an open circuit voltage 21.9V

Solar Charge Controller

The Solar Charge Controller in each of the control cabinets shall:

- Utilize an intelligent 4-stage algorithm and Pulse Width Modulation (PWM) for battery charging
- Automatically provide Low Voltage Disconnect (LVD) to protect batteries when needed
- Automatically provide Load-Reconnection once battery levels have been restored to an acceptable value
- Supply 12VDC power 24 hours a day, 7 days a week
- Protect against and automatically recover from: short circuit, overload, reverse polarity, high temperature, lightning and transient surge, as well as voltage spikes
- Be independently replaceable of other control panel components
- Operate from -40° to +140°F (-40° to +60°C)

Pole and Hardware

Each Tapco sign pole to consist of:

- 13’ 373-13, 4.25” diameter Schedule 40 aluminum pole with one end threaded.
- 293-00010 domed pole cap.
- 101802 mounting brackets with bolt and nut sets.
- 203-00014 pedestal base, cast aluminum, threaded collar, aluminum access door, FHWA certified, meets or exceeds AASHTO break-away requirements.
- 3177-42 (4) 1”x42”, galvanized steel bent anchor (foundation bolt), nut and washer (for frost or snow covered areas.
- Anchor bolts to be embedded in minimum concrete base buried flush with grade. Base design by others.

Warranty

The Manufacturer shall offer a three-year unconditional warranty against all defects in material and workmanship.

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