GALVESTON COUNTY
PURCHASING DEPARTMENT

REQUEST FOR PROPOSAL

RFP #B201044

GALVESTON COUNTY ROAD & BRIDGE FACILITY REBUILD PROJECT

PROPOSAL DUE DATE: 10/15/2020

2:15 P.M. CST

Rufus Crowder, CPPO, CPPB
Purchasing Agent
Galveston County
722 Moody (21st Street)
Fifth (5th) Floor
Galveston, Texas 77550
(409) 770-5372

REQUEST FOR PROPOSAL
GALVESTON COUNTY ROAD & BRIDGE FACILITY REBUILD PROJECT
GALVESTON COUNTY, TEXAS

Sealed proposals in **sets of four (4), one (1) unbound original, three (3) copies and one (1) electronic copy on a CD or a flash drive** will be received in the office of the Galveston County Purchasing Agent **until 2:15 P.M. CST, on Thursday, October 15, 2020** and opened immediately in that office in the presence of Galveston County Auditor and the Purchasing Agent. Sealed qualifications are to be delivered to Rufus G. Crowder, CPPO CPPB, Galveston County Purchasing Agent at the Galveston County Courthouse, 722 Moody, (21st Street), Floor 5, Purchasing, Galveston, Texas 77550, (409) 770-5372. **The time stamp clock located in the Purchasing Agent's office shall serve as the official time keeping piece for this solicitation process. Any proposals received after 2:15 P.M. CST on the specified date will be returned unopened.**

Purpose:
Galveston County issues this *competitive sealed proposal* in an effort to acquire a general contractor to perform construction services to include new buildings and site work at the following location:

Galveston County Road and Bridge Deparatment
511 TX-3
Dickinson, TX 77539

The new facility scope includes the following:

- Administrative office;
- Fleet maintenance shop;
- Fueling facility;
- Wash rack;
- Parking for vehicles and equipment;
- Work at the department's currently occupied site;
- Work on an adjacent vacant site to the south of the occupied site;
- Sitework and the construction of multiple new structures as described in the drawings and specifications.

All proposals must be marked on the outside of the envelope:
RFP #B201044
Galveston County Road & Bridge Facility Rebuild Project

Proposer's name, return address, should be prominently displayed on the proposal package for identification purposes.

Specifications can be obtained by visiting the Galveston County website @ http://www.galvestoncountytx.gov/pu/Pages/BidListings.aspx.

PRE-PROPOSAL MEETING:
A non-mandatory pre-proposal conference will be held on Thursday, September 17, 2020 at 10:00 a.m.
Due to the COVID-19 pandemic, the County of Galveston has instituted measures to guard against the spread of the virus. This includes the prohibition of in-person meetings, social distancing, and stay-at-home requirements for employees.

The Pre-Proposal Conference shall take place via video/tele-conference and the instructions are listed below and on the County's Purchasing website:

Minimum System Requirements for Video Conferencing:
1. High-resolution webcam;
2. Computer processing minimum: 2 GB of RAM and a quad-core processor;
3. Network bandwidth: 1 Mbps is sufficient for 15 fps at 720p resolution;

Calling from a mobile device:

1. Front facing camera;
2. In ear headphone with built in mic

Instructions for Video Conferencing:

1. Click here or navigate to https://guest.lifesize.com/1907077
2. Enter Name and email (optional);
3. Click the Terms of Service and Privacy Policy checkbox;
4. Click Join Meeting

***Note - be sure to enable audio and video.**

Submitted prices shall be either lump sum or unit prices as shown on proposal sheets, if applicable. The net price shall be delivered to Galveston County, including all freight, shipping, and license fees. Galveston County is tax exempt and no taxes should be included in proposal pricing.

Bonding Requirements:

- **PROPOSAL GUARANTEE:** Evidencing its firm commitment to engage in the contract if Proposer is selected for award of contract, each Proposer is required to furnish with their proposal a Cashier's Check, or an acceptable Bidder's Bond, in the amount of five percent (5%) of the total contract price. The Bidder's Bond must be executed with a surety company authorized to do business in the State of Texas. Failure to furnish the bid/proposal guarantee in the proper form and amount, by the time set for opening of bids may be cause or rejection of the proposal.

- **PERFORMANCE AND PAYMENT BONDS:**
  Successful proposer, before beginning work, shall execute a performance bond and a payment bond, each of which must be in the amount of the contract. The required payment and performance bonds must each be executed by a corporate surety in accordance with Section 1, Chapter 87, Acts of the 56th Legislature, Regular Session, 1959 (Article 7.19-1, Vernon's Texas Insurance Code).

Attention is called to the fact that not less than, the federally determined prevailing (Davis-Bacon and Related Acts) wage rate, as issued by the Office of Rural Community Affairs and contained in the contract documents, must be paid on this project. In addition, the successful bidder must ensure that employees and applicants for employment are not discriminated against because of race, color, religion, sex age or national origin.

The Galveston County Commissioners' Court reserves the right to waive any informality and to reject any and all bids and to accept the bid or bids which, in its opinion, is most advantageous to Galveston County with total respect the governing laws.

All contractors/subcontractors that are debarred, suspended or otherwise excluded from or ineligible for participation on federal assistance programs may not undertake any activity in part or in full under this project

Rufus G. Crowder, CPPO CPPB
Purchasing Agent
Galveston County

RFP #B201044
OPEN: 10/15/2020
TIME: 2:15 P.M.

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1. PROPOSAL PACKAGE

The Request for Proposal, general and special provisions, drawings, specifications/line item details, contract documents, addenda (if any), and the Proposal are all part of the Proposal package. ***PROPOSALS must be submitted in sets of four (4), one (1) unbound original, and three (3) copies and one (1) electronic copy on a CD or a flash drive*** *on the forms provided by the County if County forms are provided, and shall include the Proposal sheets completed in their entirety and signed by an authorized representative by original signature. Failure to complete and sign the proposal sheets/contract page(s) may disqualify the proposal from being considered by the Commissioners Court. Any individual signing on behalf of the Proposer expressly affirms that he or she is duly authorized to tender this proposal and to sign the proposal under the terms and conditions in this request for proposal on behalf of the Proposer and to bind the Proposer to the terms and conditions of this request for proposal and the Proposer's response hereto. Proposer further understands that Proposers' signing of the contract shall be of no effect unless the contract is subsequently awarded by the Commissioners Court and the contract properly executed by the Commissioners Court. All figures must be written in ink or typed. Figures written in pencil or with erasures are not acceptable. However, mistakes may be crossed out, corrections inserted, and initialed in ink by the individual signing the bid. If there are discrepancies between unit prices quoted and extensions, the unit price shall prevail. Each Proposer is required to thoroughly review this entire request for proposal package to familiarize themselves with the proposal procedures, the plans and specifications for the requested work, as well as the terms and conditions of the contract the successful Proposer will execute with the County.*

2. PROPOSER'S RESPONSIBILITY

The Proposer must affirmatively demonstrate its responsibility. The Proposer must also meet the following minimum requirements:

A. have adequate financial resources or the ability to obtain such resources as required;
B. be able to comply with all federal, state, and local laws, rules, regulations, ordinances and orders regarding this request for proposal;
C. have a satisfactory record of performance;
D. have a satisfactory record of integrity and ethics; and
E. be otherwise qualified and eligible to receive an award.

3. TIME FOR RECEIVING PROPOSALS

Proposals may be submitted by mail or hand delivery and **must be submitted only to the Galveston County Purchasing Agent**. If by delivery, the Proposer must deliver the Proposal to the reception desk in the County Purchasing Agent's Office. The delivery and mailing instructions for the Galveston Count Purchasing Agent are the following:

Rufus Crowder, CPPO CPPB
Galveston County Purchasing Agent
722 Moody, Fifth (5th) Floor
Galveston, Texas 77550

Proposals will **not** be accepted by facsimile transmission or by electronic mail (email) unless superseded by instructions within the Special Provisions sections of this solicitation. Proposals must be received by the County Purchasing Agent on or before the deadline for the opening of the proposals. For clarity, mailing date/postmark is **not**

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sufficient – proposals **must be received** by the County Purchasing Agent on or before the deadline. Late proposals will not be accepted and will be returned to the proposer unopened. Proposals received prior to the submission deadline will be maintained unopened until the specified time for opening.

The County Purchasing Agent will accept proposals from 8:00 a.m. to 5:00 p.m. on each business day up to the submission deadline. Business days do not include Saturdays and Sundays, and do not include other days in which the County is closed for business in observance of holidays or for other reasons.

The time-stamp clock within the County Purchasing Agent's Office shall be the official time-clock for the purpose of this solicitation and thus shall be the determinant of whether the proposal was timely received.

The proposer should prominently identify the procurement number and name on the outside of the envelope/mailing package. A label shall be provided for this purpose and usage of the label is preferred. If the proposer fails to identify the request for proposal number and name on the outside of the envelope as required, the Purchasing Agent will open the envelope for the sole purpose of identifying the solicitation number for which the submission was made. The envelope will then be resealed. No liability will attach to a County office or employee for the premature opening of a proposal.

If a proposal is not submitted, return this Request for Proposal and state reason (s), otherwise your name may be removed from the Purchasing Agent's mailing list.

4. COMPETITIVENESS, INTEGRITY, INQUIRIES AND QUESTIONS

To prevent biased evaluations and to preserve the competitiveness and integrity of the procurement process, **proposers are to direct all communications regarding this invitation to bid only to the Galveston County Purchasing Agent,** unless otherwise specifically noted.

Do not contact the requesting department. Attempts by offering firms to circumvent this requirement will be viewed negatively and may result in rejection of the proposal of the firm found to be in non-compliance.

All questions regarding this Request for Proposal must be submitted in writing to:

Rufus Crowder, CPPO CPPB, Purchasing Agent
722 Moody
Fifth (5th) Floor
Galveston, Texas 77550
Fax: (409) 621-7997
E-mail: purchasing.bids@co.galveston.tx.us

All questions received and the responses thereto will be mailed, emailed, or faxed to all prospective proposers by addendum. No inquiries except clarification of instructions will be addressed by telephone.

Proposer is advised to carefully review this Request for Proposal – it provides specific information necessary to aid participating firms in formulating a thorough response. Proposer's failure to examine all documents shall not entitle the proposer to any relief from the conditions imposing in the Request for Proposal and the resultant contract.

An authorized person from the proposer must sign the proposal. This signatory must be a person from the submitting firm who is duly authorized to tender and sign the proposal on behalf of the proposer and to bind the proposer to the terms and conditions of this Request for Proposal, the proposer's response, and all other terms and conditions of the contract. By this signature, the proposer further acknowledges that the proposer has read the request

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for proposal and proposal documents thoroughly before submitting a proposal and will fulfill the obligations in accordance to the terms, conditions, and specifications detailed herein.

5. PROPOSAL OPENING

The Purchasing Agent shall open the proposals on the date and time specified herein. Only the names of the proposers will be read at the opening. Proposals shall be opened in a manner that avoids disclosure of the contents to competing offerors and that keeps the proposals secret during negotiations. The Purchasing Agent will examine proposals promptly and thoroughly. Upon opening, no proposal may be withdrawn for a period of sixty (60) calendars days after the proposal opening date.

6. WITHDRAWAL OF PROPOSAL/FIRM BID RULE

Proposers may request withdrawal of their sealed proposal prior to the scheduled proposal opening time provided the request for withdrawal is submitted to the Purchasing Agent in writing. No proposals may be withdrawn for a period of sixty (60) calendar days after opening of the proposals.

7. COMMISSIONERS COURT

No contract is binding on the County until it is properly placed on the Commissioners Court agenda, approved in open Court, authorized to be executed by the County Judge, and fully executed by both parties.

Department heads and elected officials are not authorized to enter into any type of agreement or contract on behalf of the County. Only the Commissioners Court acting as a body may enter into a contract on behalf of and contractually bind the County. Additionally, department heads and elected officials are not authorized to agree to any type of supplemental agreements or contracts for goods or services. Supplemental agreements are subject to review by the County Legal Department prior to being accepted and signed by the County's authorized representative.

8. REJECTION OF PROPOSALS/DISQUALIFICATION

Galveston County, acting through its Commissioners Court, reserves the right to:

- reject any and all proposals in whole or in part received by reason of this request for proposal;
- waive any informality in the proposals received;
- disregard the proposal of any proposer determined to be not responsible;
- disregard the proposal of any proposer determined to have not submitted its proposal timely; and/or
- discontinue its efforts for any reason under this request for proposal package at any time prior to actual execution of contract by the County.

Proposers may be disqualified and rejection of proposals may be recommended to the Commissioners Court for any of (but not limited to) the following causes:

A. Failure to use the proposal forms furnished by the County, if applicable;
B. Lack of signature by an authorized representative of proposer;
C. Failure to properly complete the proposal;
D. Engaging in communications regarding this procurement during the pendency of this procurement with County officials and/or personnel who are not within the Purchasing Agent's Office;

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E. Failure to meet the mandatory requirements of this request for proposal; and/or
F. Evidence of collusion among proposers.

9. RESTRICTIVE OR AMBIGUOUS SPECIFICATIONS

It is the responsibility of the prospective proposer to review the entire request for proposal packet and to notify the Purchasing Agent if the specifications are formulated in a manner that would restrict competition or appear ambiguous. Any protest or question(s) regarding the specifications or proposal procedures must be received in the Purchasing Agent's Office not less than seventy-two (72) hours prior to the time set for proposal opening. Proposers are to submit their proposal as specified herein or propose an approved equal.

10. SUBSTITUTES/DESCRIPTION OF MATERIALS AND EQUIPMENT

Any brand name or manufacturer reference used herein is intended to be descriptive and not restrictive, unless otherwise noted, and is used to indicate the type and quality of material. The term "or equal" if used, identifies commercially produced items that have the essential performance and salient characteristics of the brand name stated in the item description. All supplies, material, or equipment shall be new and of the most suitable grade for the purpose intended. For clarification, "new" includes products containing recovered materials that are EPA-designated items and additionally see Section 63 of these General Provisions on contracts involving federal funds. It is not the County's intent to discriminate against any materials or equipment of equal merit to those specified. However, if proposer desires to use any substitutions, prior written approval must be obtained from the Purchasing Agent and sufficiently in advance such that an addendum may be issued. All material supplied must be one hundred percent (100%) asbestos free. Proposer, by submission of its proposal, certifies that if awarded any portion of this procurement, the proposer will supply only material and equipment that is 100% asbestos free.

11. EXCEPTIONS TO PROPOSAL

The proposer will list on a separate sheet of paper any exceptions to the conditions of this request for proposal. This sheet will be labeled, "Exceptions to Proposal Conditions", and will be attached to the proposal. If no exceptions are stated, it will be understood that all general and special conditions will be complied with, without exception.

The proposer must specify in its proposal any alternatives it wishes to propose for consideration by the County. Each alternative should be sufficiently described and labeled within the proposal and should indicate its possible or actual advantage to the program being offered.

The County reserves the right to offer these alternatives to other proposers.

12. PRICING

Proposals will be either lump sum or unit prices as shown on the proposal sheet. The net priced items will be delivered to Galveston County, including all freight, shipping, and delivery charges.

Cash discount must be shown on the proposal, otherwise prices will be considered net. Unless prices and all information requested are complete, the proposal may be disregarded and given no consideration.

In case of default by the contractor, the County of Galveston may procure the articles or services from other sources and may deduct from any monies due, or that may thereafter become due to the contractor, the difference between the

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price named in the contract of purchase order and the actual cost thereof to the County of Galveston. Prices paid by the County of Galveston shall be considered the prevailing market price at the time such purchase is made. Periods of performance may be extended if the facts as to the cause of delay justify such extension in the opinion of the Purchasing Agent and the Commissioners' Court.

13. PROCUREMENT CARD (P-CARD) PROGRAM

The County of Galveston participates in a Procurement Card (P-Card) program that allows payments made to a vendor by credit card. This method typically results in substantially faster bill payments, sometimes within three (3) to five (5) days of the actual transaction date. All transaction fees from the card provider are to be paid by the successful contractor. If your company will accept payment via credit card (Visa, MasterCard), please notate this in your Proposal submittal.

14. PASS THROUGH COST ADJUSTMENTS

Except in instances of extreme extenuating circumstances, Contractor prices shall remain firm throughout the contract period and any renewals. Examples of extreme extenuating circumstances include such situations as a nationwide rail strike, oil shortage or oil embargo.

In extreme extenuating circumstances, Contractors may be allowed to temporarily "pass through" additional costs they are forced to incur through no fault of their own. A request for a pass through cost increase will not be considered unless a Contractor's cost for the Contractor's product exceeds 10% over the original cost for the product. Also, the increase in cost must be nationwide and consistent for a minimum period of sixty (60) calendar days. Costs that historically are anticipated to rise over a period of time (for example only, such as wages or insurance costs) do not qualify for pass through. If a Contractor thinks he will be asking for a pass through cost adjustment during the term of the contract, then the original cost of the product to Contractor must be stated in Contractor's original proposal.

A request for a pass through cost does not guarantee that one will be granted. Contractors must submit such information on each request as required by the County Purchasing Agent. The County Purchasing Agent will review each request on a case-by-case basis and if valid submit the request to the Commissioners Court for authorization and determination of the appropriateness of each request as well as amount and duration of increase. Contractors will not be permitted any additional compensation for mark-ups or profits based on the increase in price. Rather, such additional compensation will be limited to the actual increase in original cost to the Contractor as such increase is reflected by the original cost stated in the bid. But in no event will the amount of additional compensation exceed 25% increase in Contractor's original cost for the product as such cost is reflected in Contractor's original proposal or the duration exceed a period of sixty (60) calendar days. In addition should the cost, during the period of the pass through, return to normal or decrease to below pre pass through prices, appropriate downward adjustments shall be made. No more than one pass through adjustment will be permitted per year.

15. MODIFICATION OF PROPOSALS

A proposer may modify a proposal by letter at any time prior to the submission deadline for receipt of proposals. Modification requests must be received by the Purchasing Agent prior to the submission deadline. Modifications made before opening time must be initialed by proposer guaranteeing authenticity. Proposals may not be amended or altered after the official opening with the single exception that any product literature and/or supporting data required by the actual specifications, if any, will be accepted at any time prior to the Commissioners Court considering of same.

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16. PRE-PROPOSAL CONFERENCE

A pre-proposal conference for the purpose of discussing contract requirements and answering questions of prospective proposers may be conducted in this procurement. A pre-proposal conference may be mandatory or voluntary. If the pre-proposal conference is mandatory, then the County is authorized to condition acceptance of a proposal on compliance with attendance. The Special Provisions of this procurement shall specify if a pre-proposal conference is to be held and shall specify whether the pre-proposal conference is mandatory or voluntary. Regardless of whether the pre-proposal conference is mandatory or voluntary, only a principal, officer, or employee of the proposer may represent the proposer at the pre-proposal conference and no person may represent more than one proposer at the pre-proposal conference.

17. SIGNATURE OF PROPOSALS

Each proposal shall give the complete name of the proposer and the mailing address of the proposer and be signed by an authorized representative by original signature with the authorized representative's name and legal title typed below the signature line. Each proposal shall include the proposer's Federal Employer Identification Number (FEIN). Failure to sign the Contract page(s) and proposal response sheets may disqualify the proposal from being considered by the County. The person signing on behalf of the proposer expressly affirms that the person is duly authorized to tender the proposal on behalf of the proposer and to sign the proposal sheets and contract under the terms and conditions of this Request for Proposal and to bind the proposer hereto and further understands that the signing of the contract shall be of no effect until it is properly placed on the Commissioners Court agenda, approved in open Court, authorized to be executed by the County Judge, and fully executed by both parties.

18. AWARD OF PROPOSALS – EVALUATION CRITERIA AND FACTORS

The award will be made to the responsible proposer whose proposal is determined to be the lowest and best evaluated offer demonstrating the best ability to fulfill the requirements set forth in this Request for Proposal. **The proposed cost to the County will be considered firm and cannot be altered after the submission deadline, unless the County invokes its right to request a best and final offer.**

"Lowest and best" means a bid or offer providing the best value considering associated direct and indirect costs, including transport, maintenance, reliability, life cycle, warranties, and customer service after a sale.

In determining the lowest and best bid for a contract for the purchase of earth-moving, material-handling, road maintenance, or construction equipment, the Commissioners Court may also consider the information submitted under Section 262.0255 of the Local Government Code; and in determining the lowest and best bid for a contract for the purchase of road construction material, the Commissioners Court may consider the pickup and delivery locations of the bidders and the cost to the county of delivering or hauling the material to be purchased. The Commissioners Court may award contracts for the purchase of road construction material to more than one bidder if each of the selected bidders submits the lowest and best bid for a particular location or type of material.

Each proposer, by submitting a proposal, agrees that if its' proposal is accepted by the Commissioners Court, the proposer will furnish all items and services upon which prices have been tendered and upon the terms and conditions in this proposal, including but not limited to the best and final offer if applicable, and the contract.

The contractor shall commence work only after the transmittal of a fully executed contract and after receiving written notification to proceed from the County Purchasing Agent. The contractor will perform all services indicated in the proposal in compliance with this contract.

Neither department heads nor elected officials are authorized to sign any binding contracts or agreements prior to being properly placed on the Commissioners' Court agenda and approved in open court. Department heads and other elected officials are not authorized to enter into any type of agreement or contract on behalf of Galveston County.

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Only the Commissioners Court, acting as a body, may enter into a contract on behalf of the County. Additionally, department heads and other elected officials are not authorized to agree to any type of supplemental agreements or contracts for goods or services. Supplemental agreements are subject to review by the County Legal Department prior to being signed by the County's authorized representatives.

The County of Galveston reserves the right to accept proposals on individual items listed, or group items, or on the proposal as a whole; to reject any and all proposals; to waive any informality in the proposals; to disregard proposals that are not submitted timely; to disregard the proposals of proposers determined to be not responsible; and to accept the proposal that appears to be in the best interest of the County. The selection process may, however, include a request for additional information or an oral presentation to support the written proposal.

In determining and evaluating the best proposal , the pricing may not necessarily be controlling, but quality, equality, efficiency, utility, general terms, delivery, suitability of the service offered, and the reputation of the service in general use will also be considered along with any other relevant items. The Commissioners Court shall be the sole judge in the determination of these matters.

The County reserves the right to reject any or all proposals in whole or in part received by reason of this Request for Proposal and may discontinue its efforts under this Request for Proposal for any reason or no reason or solely for the County's convenience at any time prior to actual execution of the contract by the County.

A Proposer whose proposal does not meet the mandatory requirements set forth in this request for proposal will be considered non-compliant.

The invitation to submit a proposal which appears in the newspaper, or other authorized advertising mediums, these general provisions, the specifications which follow, the proposal sheets, and any addenda issued are all considered part of the proposal.

Each proposer, by submitting a proposal, agrees that if its proposal is accepted by the Commissioners Court, such proposer will furnish all items and services upon the terms and conditions in this request for proposal and the resultant contract.

Notice of contract award is anticipated to be made within ninety (90) days of opening of proposals to the lowest responsive and responsible contractor, whose proposal complies with all the requirements in the request for proposal.

Contractor shall submit to the County, for approval, within ten (10) days from notice of contract award, all Certificates of Insurance evidencing the required coverage as described under Section 37, Requirement of and Proof of Insurance, or if different, then as described within the Special Provisions or resultant contract.

The contractor shall not commence work under these terms and conditions of the contract until all applicable Purchase Orders, Certificates of Insurance, Performance and Payment Bonds, and Irrevocable Letters of Credit (if required) have been approved by the County of Galveston and the Contractor has received notice to proceed in writing and an executed copy of the contract from the County Purchasing Agent.

19. DISPUTE AFTER AWARD/PROTEST

Any actual or prospective Proposer who is allegedly aggrieved in connection with this procurement or award of a contract resulting therefrom may protest. The protest shall be submitted in writing to the Purchasing Agent within seven (7) calendar days after such aggrieved person knows of or should have known of the facts giving rise thereto. If the protest is not resolved by mutual agreement, the Purchasing Agent will promptly issue a decision in writing to the protestant. If the protestant wishes to appeal the decision rendered by the Purchasing Agent, such appeal must be

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made to the Commissioners Court through the Purchasing Agent. The decision of the Commissioners Court will be final. The Commissioners Court need not consider protests unless this procedure is followed.

20. PUBLIC INFORMATION ACT (f/k/a Open Records Act)

The proposer acknowledges that the County is a government body for purposes of the Public Information Act, codified as Chapter 552 of the Texas Government Code, and as such is required to release information in accordance with the provisions of the Public Information Act.

If proposer considers any of its submitted information to be proprietary in nature, trade secret, or otherwise confidential, then it must clearly and conspicuously mark such information as proprietary, trade, secret, or confidential. By the submission of its proposal, proposer expressly affirms that it has clearly and conspicuously marked any information within its submission that proposer considers confidential, proprietary, and/or trade secret.

In the event the County receives a request for information under the Public Information Act seeking information that the proposer has marked as confidential, proprietary, and /or trade secret, then the County agrees that it shall provide notice to the proposer of the request for information and the request for decision process under the Public Information Act. Thus, the County will submit the initial correspondence to the Texas Attorney General – however, the burden is and shall be on the proposer to submit correspondence to the Attorney General if the proposer wishes its information to be withheld. Proposer is deemed to have knowledge of the Public Information Act. **By the submission of its proposal, proposer expressly acknowledges that the burden to withhold its' information from public disclosure lays with the proposer;** thus, proposer further acknowledges and agrees that it shall submit comments to the Texas Attorney General in the request for decision process if proposer wishes to have its' information withheld from public disclosure.

21. PROPOSER'S E-MAIL ADDRESSES – CONSENT TO DISCLOSURE

Notwithstanding the foregoing Section 20, proposer acknowledges and agrees that the confidentiality of any and all email addresses proposer uses or discloses in communicating with the County are **open** to the public in accordance with Section 552.137 of the Government Code and proposer consents to the release of its email addresses.

22. RESULTANT CONTRACT

Proposer shall correctly and fully execute the resultant contract first. After this, the contract shall be set for consideration by the Commissioners Court. If the Commissioners Court authorizes the execution of the contract, the resultant contract shall become effective upon the Commissioners Court execution of same, provided that the contract is executed by all parties to the contract. Contract documents shall consist of the contract, the General and Special Provisions, drawings, proposal package (including best and final offer(s) if such is utilized), any addenda issued, and any change orders issued during the work. If applicable to the attached proposal, proposer must sign three (3) original contracts and return all three with their proposal submittal.

Proposer should submit a proposed contract with its proposal or its sample material terms and conditions for review and consideration.

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23. CONTRACT TERM

The term of the resultant contract will begin on the date of full execution or the execution by the Commissioners Court, whichever is later, and will terminate on the date specified in the resultant contract unless terminated earlier as herein set forth.

24. TERMINATION FOR DEFAULT

Failure of either party in the performance of any of the provisions of this contract shall constitute a breach of contract, in which case either party may require corrective action within ten (10) business days from date of receipt of written notice citing the exact nature of such breach. Failure of the party being notified to take corrective action within the prescribed ten (10) business days, or failure to provide written reply of why no breach has occurred, shall constitute a Default of Contract.

All notices relating to default by proposer of the provisions of the contract shall be issued by the County through its Legal Department, and all replies shall be made in writing to the County Legal Department. Notices issued by or issued to anyone other than the County Legal Department shall be null and void and shall be considered as not having been issued or received.

Galveston County reserves the right to enforce the performance of this contract in any manner prescribed by law in the event of breach or default of this contract, and may contract with another party, with or without solicitation of proposals or further negotiations. At a minimum, proposer shall be required to pay any difference in service or materials, should it become necessary to contract with another source, plus reasonable administrative costs and attorney fees.

In the event of Termination for Default, Galveston County, its agents or representatives shall not be liable for loss of any profits anticipated to be made by proposer.

In addition to the remedies stated herein, the County has the right to pursue other remedies permitted by law or in equity.

No waiver by either party of any event of default under this agreement shall operate as a waiver of any subsequent default under the terms of this agreement.

County reserves the right to terminate this contract immediately in the event proposer:

A. Fails to meet delivery or completion schedules; and/or
B. Fails to otherwise perform in accordance with the accepted proposal and the contract.

25. TERMINATION FOR CONVENIENCE

County may terminate this contract upon at least thirty (30) calendar days prior written notice for its convenience or for any reason deemed by the County to serve the public interest. As well, County may terminate this contract upon thirty (30) calendar days prior written notice for any reason resulting from any governmental law, order, ordinance, regulation, or court order. In no event shall County be liable for loss of any profits anticipated to be made hereunder by proposer should this contract be terminated early.

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26. FORCE MAJEURE

If by reason of Force Majeure either Party shall be rendered unable, wholly or in part, to carry out its responsibilities under this contract by any occurrence by reason of Force Majeure, then the Party unable to carry out its responsibility shall give the other Party notice and full particulars of such Force Majeure in writing within a reasonable time after the occurrence of the event, and such notice shall suspend the Party's responsibility for the continuance of the Force Majeure claimed, but for no longer period.

Force Majeure means acts of God, floods, hurricanes, tropical storms, tornadoes, earthquakes, or other natural disasters, acts of a public enemy, acts of terrorism, sovereign conduct, riots, civil commotion, strikes or lockouts, and other causes that are not occasioned by either Party's conduct which by the exercise of due diligence the Party is unable to overcome and which substantially interferes with operations.

27. ESTIMATED QUANTITIES

Any reference to quantities shown in the request for proposal is an estimate only. Since the exact quantities cannot be predetermined, the County reserves the right to adjust quantities as deemed necessary to meet its requirements.

28. CONTRACTOR INVESTIGATION

Before submitting a proposal, each proposer shall make all investigations and examinations necessary to ascertain all site conditions and requirements affecting the full performance of the contract and to verify any representations made by the County upon which the contractor will rely. Proposer shall exercise due diligence and is further charged with knowledge of the local, State, and Federal laws, rules, and regulations applicable to this contract. If the proposer receives an award as a result of its proposal submission in this procurement, the proposer's failure to have made such investigations and examinations will in no way relieve the proposer from its obligation to comply in every detail with all provisions and requirements of the contract, nor will a plea of ignorance of such conditions and requirements be accepted as a basis for any claim whatsoever by the contractor for additional compensation and/or for excused nonperformance.

29. NO COMMITMENT BY COUNTY OF GALVESTON

This request for procurement does not commit the County of Galveston to award any costs or pay any costs, or to award any contract, or to pay any costs associated with or incurred in the preparation of a proposal in response to this request for proposal and does not commit the County of Galveston to procure or contract for services or supplies.

30. PROPOSAL COSTS BORNE BY PROPOSER

Galveston County shall not be liable for any costs incurred by proposer in preparation, production, or submission of a proposal, including but not limited to best and final offer if applicable. As well, Galveston County shall not be liable for any work performed by proposer prior to issuance of fully executed contract and properly issued notice to proceed. Galveston County shall not be liable for any costs incurred by proposer by reason of attending a pre-proposal conference. Galveston County shall not be liable for any costs incurred by proposer by reason of the County invoking use of best and final offers.

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31. BEST AND FINAL OFFERS (BAFO)

In acceptance of proposals, the County reserves the right to negotiate further with one or more of the proposers as to any features of their proposals and to accept modifications of the work and price when such action will be in the best interest of the County. This includes, but is not limited to, the solicitation of a Best and Final Offer from one or more of the proposers. If a Best and Final Offer is invoked, this allows acceptable proposers the opportunity to amend, change, or supplement their original proposal. Proposers may be contacted in writing by the Purchasing Agent, requesting that they submit their Best and Final Offer. Any such Best and Final Offer must include discussed and negotiated changes.

32. SINGLE PROPOSAL RESPONSE

If only one proposal is received in response to the request for proposal, a detailed cost proposal may be requested of the single proposer. A cost/price analysis and evaluation and/or audit may be performed of the cost proposal in order to determine if the price is fair and reasonable.

33. CHANGES IN SPECIFICATIONS

If it becomes necessary to revise any part of this proposal, a written notice of such revision will be provided to all proposers in the form of addenda. The County is not bound by any oral representations, clarifications, or changes made in the written specifications by the County's employees or officials, unless such clarification or change is provided to proposers in a written addendum from the Purchasing Agent. Proposers are advised to inquire prior to the submission deadline as to whether any addenda to this request for proposal have been issued, as the successful proposer will be required to abide by such addenda.

The County of Galveston reserves the right to revise or amend the specifications up to the time set for opening of proposals. Such revisions and amendments, if any, shall be announced by form of addenda. Copies of such addenda (or addendum in the event only one addendum is issued in the procurement) shall be furnished to all prospective contractors. Prospective contractors are defined as those contractors listed on the County's request for proposal list for this material/service or those who have obtained documents from the Purchasing Agent's Office subsequent to the advertisement. If revisions and amendments require changes in quantities or prices proposed, or both, the date set for opening of proposals may be postponed by such number of days as in the opinion of the County shall enable prospective contractors to revise their proposals. In any case, the proposal opening shall be at least seven (7) business days after the last revising or amendment addendum and the addendum shall include an announcement of the new date, if applicable, for the opening of proposals.

34. PROPOSAL IDEAS AND CONCEPTS

The County reserves to itself the right to adopt or use for its benefit, any concept, plan, or idea contained in any proposal.

35. PROPOSAL DISCLOSURES

While this procurement is pending, the names of those who submitted proposals will not be made public unless in conformity with the County Purchasing Act. Likewise, no pricing, staffing, or other contents of the proposal information will be released unless in conformity with the County Purchasing Act. Proposers are requested to withhold all inquiries regarding their proposal or other submissions until after an award is made. No communication is to be had with any County employee or official, other than the County Purchasing Agent, regarding whether a proposal was received - violations of this provision may result in the rejection of a proposal.

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36. INDEMNIFICATION

The contractor agrees to assume all risks and responsibility for, and agrees to indemnify, defend, and save harmless, the County of Galveston, its elected and appointed officials and department heads, and its agents and employees from and against all claims, demands, suits, actions, recoveries, judgments, and costs and expenses including reasonable attorney's fees for the defense thereof, arising out of or in connection therewith on account of the loss of life, property or injury or damage to the person which shall arise from contractor's operations under this contract, its use of County facilities and/or equipment or from any other breach on the part of the contractor, its employees, agents or any person(s), in or about the County's facilities with the expressed or implied consent of the County. Contractor shall pay any judgment with cost which may be obtained against Galveston County resulting from contractor's operations under this contract.

Contractor agrees to indemnify and hold the County harmless from all claims of subcontractors, laborers incurred in the performance of this contract. Contractor shall furnish satisfactory evidence that all obligations of this nature herein above designated have been paid, discharged or waived. If Contractor fails to do so, then the County reserves the right to pay unpaid bills of which County has written notice direct and withhold from Contractor's unpaid compensation a sum of money reasonably sufficient to liquidate any and all such lawful claims.

37. REQUIREMENT OF AND PROOF OF INSURANCE

The successful proposer shall furnish evidence of insurance to the County Purchasing Agent and shall maintain such insurance as required hereunder or as may be required in the Special Provisions or resultant contract, if different. Contractor shall obtain and thereafter continuously maintain in full force and effect, commercial general liability insurance, including but not limited to bodily injury, property damage, and contractual liability, with combined single limits as listed below or as may be required by State or Federal law, whichever is greater.

A. For damages arising out of bodily injury to or death of one person in any one accident :
ONE HUNDRED THOUSAND AND NO/100 ($100,000.00) DOLLARS.

B. For damages arising out of bodily injury to or death of two or more persons in any one accident:
THREE HUNDRED THOUSAND AND NO/100 ($300,000.00) DOLLARS.

C. For any injury to or destruction of property in any one accident :
ONE HUNDRED THOUSAND AND NO/100 ($100,000.00) DOLLARS.

Insurance shall be placed with insurers having an A.M. Best's rating of no less than A. Such insurance must be issued by a casualty company authorized to do business in the State of Texas, and in standard form approved by the Board of Insurance Commissioners of the State of Texas, with coverage provisions insuring the public from loss or damage that may arise to any person or property by reason of services rendered by Contractor.

Galveston County shall be listed as the additional insured on policy certificates and shall be provided with no less than thirty (30) calendar days prior notice of any changes to the policy during the contractual period.

Certificates of Insurance, fully executed by a licensed representative of the insurance company written or countersigned by an authorized Texas state agency, shall be filed with the County Purchasing Agent within ten (10) business days of issuance of notification from the County Purchasing Agent to proposer that the contract is being activated as written proof of such insurance and further provided that proposer shall not commence work under this contract until it has obtained all insurance required herein, provided written proof as required herein, and received written notice to proceed issued from the County Purchasing Agent.

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Proof of renewal/replacement coverage shall be provided prior to the expiration, termination, or cancellation date of any policy and Galveston County shall be named as an additional insured on any such renewal/replacement coverage and a certificate of insurance showing such shall be provided to the Purchasing Agent. Said insurance shall not be cancelled, permitted to expire, or changed without at least thirty (30) days prior written notice to the County.

Insurance required herein shall be maintained in full force and effect during the life of this contract and shall be issued on an occurrence basis. Contractor shall require that any and all subcontractors that are not protected under the Contractor's own insurance policies take and maintain insurance of the same nature and in the same amounts as required of Contractor and provide written proof of such insurance to Contractor. Proof of renewed/replacement coverage shall be provided prior to the expiration, termination, or cancellation date of any policy. Contractor shall not allow any subcontractor to commence work on the subcontract until such insurance required for the subcontractor has been obtained and approved.

Workers' Compensation Insurance: Successful proposer shall carry in full force Workers' Compensation Insurance Policy(ies), if there is more than one employee, for all its' employees, including but not limited to full time, part time, and emergency employees employed by the successful proposer. Current insurance certificates certifying that such policies as specified above are in full force and effect shall be furnished by successful proposer to the County.

Insurance is to be placed with insurers having a Best rating of no less than A. The proposer shall furnish the County with certificates of insurance and original endorsements affecting coverage required by these insurance clauses within ten (10) business days of receiving notification from the County Purchasing Agent that the contract is being activated. The certificates and endorsements for each insurance policy are to be signed by a person authorized by the insurer to bind coverage on its behalf. The proposer shall be required to submit annual renewals for the term of this contract prior to expiration of any policy.

In addition to the remedies stated herein, the County has the right to pursue other remedies permitted by law or in equity.

The County agrees to provide proposer with reasonable and timely notice of any claim, demand, or cause of action made or brought against the County arising out of or related to utilization of the property. Proposer shall have the right to defend any such claim, demand, or cause of action at its sole cost and expense and within its sole and exclusive discretion. The County agrees not to compromise or settle any claim or cause of action arising out of or related to the utilization of the property without the prior written consent of the proposer.

In no event shall the County be liable for any damage to or destruction of any property belonging to the proposer.

Subrogation Waiver. Proposer and proposer's insurance carrier waive any and all rights to subrogation against Galveston County in regard to any suit or claim arising out of personal injury or property damage resulting from proposer's performance under this agreement.

38. PROPOSAL GUARANTEE

Unless specified differently within the Special Provisions of this procurement, each proposer shall be required to submit a proposal guarantee with its proposal as required within this Section.

Evidencing its firm commitment to engage in contract if proposer is selected for award of contract, each proposer is required to furnish with their bid a cashier's check or an acceptable proposer's bond (generally, a bid bond) in the amount of five percent (5%) of the total contract price. If proposer is using a bond, then the bond must be executed with a surety company authorized to do business in the State of Texas. Failure to furnish the proposal guarantee in the proper form and amount, by the time set for opening of proposals may be cause for rejection of the proposal.

The cashier's check or proposer bond (as applicable) will be returned to each respective unsuccessful proposer(s)

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subsequent to the Commissioners Court award of contract, and shall be returned to the successful proposer upon the completion and submission of all contract documents. Provided however, that the cashier's check or proposer bond will be forfeited to the County as liquidated damages should successful proposer fail to execute the contract within thirty (30) days after receiving notice of the acceptance of its proposal.

39. PERFORMANCE AND PAYMENT BONDS (if required)

Successful proposer, before beginning work, shall execute a performance bond and a payment bond, each of which must be in the amount of the contract. The required payment and performance bonds must each be executed by a corporate surety authorized to write surety bonds in the State of Texas and in accordance with Chapter 3503 of the Insurance Code (codified in 2005 and originally within Section 1, Chapter 87, Acts of the 56th Leg., R.S., 1959, and in Article 7.19-1, Vernon's Texas Insurance Code).

The performance and payment bonds must each clearly and prominently display on the bond or on an attachment to the bond:

a.) The name, mailing address, physical address, and telephone number, including the area code, of the surety company to which any notice of claim should be sent; or

b.) The toll-free telephone number maintained by the Texas Department of Insurance under Subchapter B, Chapter 521, Insurance Code, and a statement that the address of the surety company to which any notice of claim should be sent may be obtained from the Texas Department of Insurance by calling the toll free-telephone number.

The performance bond shall be solely for the protection of Galveston County, in the full amount of the contract, and conditioned on the faithful performance of the work in accordance with the plans, specifications, and contract documents. The payment bond is solely for the protection and use of payment bond beneficiaries who have a direct contractual relationship with the prime contractor or a subcontractor to supply labor or material, and in the amount of the contract.

The payment and performance bonds required to be furnished herein must be furnished before the contractor begins work and are a requirement for issuance of a Notice to Proceed. Such bonds must be furnished to the Galveston County Purchasing Agent within thirty (30) calendar days after the date of the full execution of the contract or, if applicable, as required under Chapter 2253, Government Code, whichever is earlier. Contractor's failure to provide the required payment and performance bonds within such time period shall constitute an event of default under this contract. Contractor shall not commence work until all applicable certificates of insurance, performance bonds, and payment bonds have been received and approved by the County Purchasing Agent and the Contractor receives notice to proceed in writing that has been issued by the County Purchasing Agent.

Additionally, if this request for proposal is for the award of a public works contract, then compliance with Chapter 2253 of the Texas Government Code, which is known as the McGregor Act, is mandatory. Performance and payment bonds are required to be furnished in accordance with Chapter 2253 of the Texas Government Code. Proposer should familiarize itself with the entire provisions of Chapter 2253 of the Texas Government Code.

40. PATENT AND COPYRIGHT PROTECTION

The proposer agrees at its sole expense to protect the County from claims involving infringement of patents, copyright, trademark, trade secret, or other intellectual property rights. **Proposer shall indemnify and save harmless the County of Galveston, its officers, employees, and agents, from liability of any nature and kind whatsoever, including without limitation cost and expenses, for or on account of any copyrighted, trademarked, trade secret, patented or un-patented invention, process, or article manufactured or used in the performance of the contract, or other intellectual property rights, including its use by the County.** Proposer also agrees that if

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proposer is awarded this contract, that no work performed hereunder shall be subject to patent, copyright, or other intellectual property by proposer.

41. CONFLICT OF INTEREST DISCLOSURE REPORTING (FORM CIQ)

Proposer may be required under Chapter 176 of the Texas Local Government Code to complete and file a conflict of interest questionnaire (CIQ Form). The CIQ Form pertains to business relationship, gift giving and family relationship reporting. If proposer is required to file a CIQ Form, then the completed CIQ Form must be filed with the County Clerk of Galveston County, Texas.

Business relationship. If proposer has an employment or other business relationship with a local government officer of Galveston County or with a family member of a local government officer of Galveston County that results in the officer or family member of the officer receiving taxable income that exceeds $2,500.00 during the preceding 12-month period, then proposer **MUST** complete a CIQ Form and file the original of the CIQ Form with the County Clerk of Galveston County.

Gift-giving. If proposer has given a local government officer of Galveston County or a family member of a local government officer of Galveston County one or more gifts with an aggregate value of more than one-hundred dollars ($100.00) during the preceding 12-months, then proposer **MUST** complete a CIQ Form and file the original of the CIQ Form with the County Clerk of Galveston County.

Family member. For purposes of the business relationship and gift giving reporting requirements, a "family member" means a person related to another person with the first degree of consanguinity or affinity, as described by Subchapter B, Chapter 573, Texas Government Code. Examples of persons within the first degree by consanguinity or affinity include a son, daughter, father, mother, spouse, son-in-law, daughter-in-law, father-in-law, mother-in-law, stepson, stepdaughter, stepmother, and stepfather.

Family relationship. If proposer has a "family relationship" with a local government officer of Galveston County then proposer **MUST** complete a CIQ Form and file the original of the CIQ Form with the County Clerk of Galveston County, regardless of whether proposer has a business relationship or has given gifts to the local government officer or a family member of the local government officer. For this purpose, "family relationship" means proposer is related within the third degree by consanguinity or the second degree by affinity, as those terms are defined under Chapter 573 of the Texas Government Code, to a local government officer of Galveston County. Examples of such relationships include a son, daughter, mother, father, brother, sister, grandchild, great-grandchild, grandparent, great-grandparent, niece, nephew, uncle, aunt, spouse, mother-in-law, father-in-law, daughter-in-law, son-in-law, spouse's grandchild, spouse's grandparent, grandparent's spouse, grandchild's spouse, stepson, stepdaughter, stepmother, and stepfather.

Proposer must file its original CIQ Form with the Galveston County Clerk. The Galveston County Clerk has offices at the following locations:

Galveston County Clerk
Galveston County Justice Center, Suite 2001
600 59th Street
Galveston, Texas 77551

Galveston County Clerk
North County Annex, 1st Floor
174 Calder Road
League City, Texas 77573

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Again, if proposer is required to file a CIQ Form, the original completed form is filed with the Galveston County Clerk (**not the Purchasing Agent**).

For proposer's convenience, a blank CIQ Form is enclosed with this proposal package. Blank CIQ Form(s) may also be obtained by visiting the Purchasing Agent's website – this website is linked from the Galveston County homepage, at http://www.galvestoncountytx.gov.

Chapter 176 specifies deadlines for the filing of CIQ Forms (both initial filings and updated filings).

It is proposer's sole responsibility to file a true and complete CIQ Form with the Galveston County Clerk if proposer is required to file by the requirements of Chapter 176 of the Local Government Code. Proposer is advised that it is an offense to fail to comply with the disclosure reporting requirements dictated under Chapter 176 of the Texas Local Government Code, and the failure to file may be grounds to void the contract, if proposer is awarded a contract.

If proposer has any questions about compliance with Chapter 176, proposer may wish to consult its' legal counsel. Compliance is the individual responsibility of each person, business, and agent who is subject to Chapter 176 of the Texas Local Government Code.

42. DISCLOSURE OF INTERESTED PARTIES/FORM 1295

Under Section 2252.908 of the Government Code, any business entity that enters into a contract with Galveston County that requires the approval of the Commissioners Court must submit a "Disclosure of Interested Parties" to the County prior to the execution of the contract. This form, the "Disclosure of Interested Parties" form was promulgated by the Texas Ethics Commission, and is the "Form 1295". **This procurement is subject to these requirements.**

The Texas Ethics Commission was charged with promulgating rules to implement Section 2252.908 of the Government Code. The rules adopted by the Texas Ethics Commission are located at Sections 46.1, 46.3, and 46.5 of Title 1 of the Texas Administrative Code. Thus, the law covering these requirements is located at Section 2252.908 of the Government Code, and in Title 1, Sections 46.1, 46.3, and 46.5 of the Texas Administrative Code.

The Texas Ethics Commission's website is: www.ethics.state.tx.us. The area of the Texas Ethics Commission website pertaining to Form 1295 is:

www.ethics.state.tx.us/whatsnew/elf_info_form1295.htm.

Form 1295 must be completed electronically through the Texas Ethics Commission website (handwritten forms are not allowable). Once the business entity has completed their electronic filing of Form 1295, then the business entity must print out the electronically completed form, and sign and notarize the Form 1295. Once Form 1295 is signed and notarized, the business entity must submit their completed, signed, and notarized Form 1295 to the Galveston County Purchasing Agent.

Successful Proposer is and shall be subject to these requirements, and no resultant contract may be executed by the Commissioners Court until the completed, signed, and notarized Form 1295 is on file with the County Purchasing Agent.

No portion of the Form 1295 process commits the County to any type of award of contract whatsoever.

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After the Purchasing Agent's Office receives the completed, signed, and notarized Form 1295, the Purchasing Agent's Office will, within 30 days, go the Texas Ethics Commission website to submit electronic confirmation of the County's receipt of the completed, signed, and notarized Form 1295.

43. CERTIFICATION REGARDING DEBARMENT, SUSPENSION, PROPOSED DEBARMENT, AND OTHER RESPONSIBILITY MATTERS & REQUIREMENT TO REGISTER IN SAM

Proposer certifies that neither it, nor any of its Principals, are presently debarred, suspended, proposed for debarment, disqualified, excluded, or in any way declared ineligible for the award of contracts by any Federal agency. Contractor agrees that it shall refund Galveston County for any payments made to Contractor while ineligible. Contractor acknowledges that Contractor's uncured failure to perform under this Agreement, if such should occur, may result in Contractor being debarred from performing additional work for the County, the respecting State Agency administering the grant funding the contract, if applicable, the State, FEMA or HUD (as applicable), and other Federal and State entities. Further, proposer has executed the Certification Regarding Debarment, Suspension, Proposed Debarment, and Other Responsibility Matters and returned the fully completed and executed original certification with the submission of its proposal. **The truthful and fully completed and executed original of the Certification Regarding Debarment, Suspension, Proposed Debarment, and Other Responsibility Matters <u>must</u> be included with the submission of proposer's proposal and is a mandatory requirement of this request for proposal. Proposer's failure to include the fully completed and executed original of this Certification shall be considered non-compliance with the requirements of this request for proposal and grounds for the rejection of proposer's proposal.** Proposer shall immediately notify the County Purchasing Agent if it becomes debarred or suspended, placed on the Consolidated List of Debarred Contractors, or in any other way becomes ineligible for award of contract by any Federal agency. This Certification is a material fact relied upon by Galveston County; if it is later determined that the contractor did not comply with 2 C.F.R. Part 180 and 2 C.F.R. Part 3000, in additional to the remedies available to Galveston County and the State agency administering this grant, the Federal Government may pursue available remedies, including but not limited to suspension and/or debarment of contractor.

If the contract to be awarded pursuant to this procurement involves the use of Federal funds, then proposer must also be registered in the Federal Contractor Registry through the System for Award Management (SAM) to be eligible for award of contract pursuant to this procurement.

Information regarding the SAM is available at:

http://www.federalcontractorregistry.com/?gclid=CIG1hf2rr8wCFYkCaQoducANZw or at https://www.sam.gov/portal/SAM/#1.

No contract involving the use of Federal funds may be awarded to any proposer unless and until such registration is current and in good standing under SAM. Successful proposer must maintain SAM registration throughout the entire term of the agreement with the County. If this contract involves the use of Federal funds, then proposer must enclose proof of such SAM registration within its response, which is also a mandatory requirement of this procurement; failure to enclose such proof shall be considered non-compliance with the requirements of this procurement and grounds for the rejection of proposer's response to this procurement (i.e., bid, proposal, or qualifications statement, as applicable).

44. SOVEREIGN IMMUNITY

The County specifically reserves any claim it may have to sovereign, qualified, or official immunity as a defense to any action arising in conjunction with this contract.

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45. CONTROLLING LAW AND VENUE

Proposer acknowledges and agrees that the contract is and shall be governed and construed by the laws of the State of Texas and that venue shall lie exclusively in a court of competent jurisdiction in Galveston County, Texas.

46. MERGERS, ACQUISITIONS

The Proposer shall be required to notify the County of any potential for merger or acquisition of which there is knowledge at the time that a proposal is submitted.

If subsequent to the award of any contract resulting from this request for proposal the proposer shall merge or be acquired by another firm, the following documents must be submitted to the County:

A. Corporate resolutions prepared by the awarded Bidder and the new entity ratifying acceptance of the original contract, terms, conditions and prices;
B. New entity's Federal Identification Number (FEIN);
C. New entity's proposed operating plans;
D. New entity's proof of registration in SAM for contracts involving Federal funds;
E. New entity's certification regarding debarment;
F. New entity's certification regarding lobbying; and
G. W-9 Form for new entity

Moreover, proposer is required to provide the County with notice of any anticipated merger or acquisition as soon as proposer has actual knowledge of the anticipated merger or acquisition. The New Proposer's proposed plan of operation must be submitted prior to merger to allow time for submission of such plan to the Commissioners' Court for its approval.

47. DELAYS

The County reserves the right to delay the scheduled commencement date of the contract if it is to the advantage of the County. There shall be no additional costs attributed to these delays should any occur. Proposer agrees it will make no claims for damages, for damages for lost revenues, for damages caused by breach of contract with third parties, or any other claim by proposer attributed to these delays, should any occur. In addition, proposer agrees that any contract it enters into with any third party in anticipation of the commencement of the contract will contain a statement that the third party will similarly make no claim for damages based on delay of the scheduled commencement date of the contract.

48. ACCURACY OF DATA

Information and data provided through this request for proposal are believed to be reasonably accurate.

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49. SUBCONTRACTING/ASSIGNMENT

Proposer shall not assign, sell, or otherwise transfer its contract in whole or in part without prior written permission of the County acting by and through its Commissioners' Court. Such consent, if granted, shall not relieve the proposer of any of its responsibilities under this contract.

50. INDEPENDENT CONTRACTOR

Proposer expressly acknowledges that it is an independent contractor. Nothing in this agreement is intended nor shall be construed to create an agency relationship, an employer/employee relationship, a joint venture relationship, or any other relationship allowing County to exercise control or direction over the manner or method by which proposer or proposer's subcontractors perform in providing the requirements stated in the request for proposal.

51. MONITORING PERFORMANCE

The County shall have the unfettered right to monitor and audit the proposer's work in every respect. In this regard, the proposer shall provide its full cooperation and insure the cooperation of its employees, agents, assigns, and subcontractors. Further, the proposer shall make available for inspection and/or copying when requested, original data, records, and accounts relating to the proposer's work and performance under this contract. In the event any such material is not held by the proposer in its original form, a true copy shall be provided.

52. SUBJECT TO APPROPRIATION OF FUNDS

State law prohibits the obligation and expenditure of public funds beyond the fiscal year for which a budget has been approved by the Commissioners Court. Galveston County anticipates this to be an integral part of future budgets to be approved during the periods of this contract, except for unanticipated needs or events which may prevent such payments against this contract. However, Galveston County cannot guarantee the availability of funds, and enters into this contract only to the extent such funds are made available through appropriation (allocation) by the Commissioners Court. This contract shall not be construed as creating any debt on behalf of the County of Galveston in violation of TEX. CONST. art. XI, § 7, and it is understood that all obligations of Galveston County are subject to the availability of funds.

53. CONTRACTS SUBJECT TO GRANT FUNDING

Notwithstanding the foregoing, if the contract to be awarded by this procurement is funded with Federal or State grant funds, the proposer acknowledges that the obligations of the County under the contract are contingent upon the continued availability of grant funding to meet the County's obligations. If the grant(s) to the County is reduced, de-obligated, or otherwise discontinued or terminated, Contractor agrees that the County may immediately terminate the contract without penalty or any liability whatsoever on the part of the County, the State, or the Federal awarding agency.

54. PROCUREMENT ETHICS

Galveston County is committed to the highest ethical standards. Therefore, it is a serious breach of the public trust to subvert the public purchasing process by directing purchases to certain favored vendors, or to tamper with the competitive bidding process, whether it's done for kickbacks, friendship or any other reason. Since misuse of the

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purchasing power of a local government carries criminal penalties, and many such misuses are from a lack of clear guidelines about what constitutes an abuse of office, the Code of Ethics outlined below must be strictly followed.

Galveston County also requires ethical conduct from those who do business with the County.

CODE OF ETHICS – Statement of Purchasing Policy:
Public employment is a public trust. It is the policy of Galveston County to promote and balance the objective of protecting the County's integrity and the objective of facilitating the recruitment and retention of personnel needed by Galveston County. Such policy is implemented by prescribing essential standards of ethical conduct without creating unnecessary obstacles to entering public office.

Public employees must discharge their duties impartially so as to assure fair competitive access to governmental procurement by responsible contractors. Moreover, they should conduct themselves in such a manner as to foster public confidence in the integrity of the Galveston County procurement organization.

To achieve the purpose of this Article, it is essential that those doing business with Galveston County also observe the ethical standards prescribed herein.

General Ethical Standards:
It shall be a breach of ethics to attempt to realize personal gain through public employment with Galveston County by any conduct inconsistent with the proper discharge of the employee's duties.

It shall be a breach of ethics to attempt to influence any public employee of Galveston County to breach the standards of ethical conduct set forth in this code.

It shall be a breach of ethics for any employee of Galveston County to participate directly or indirectly in a procurement when the employee knows that:

- The employee or any member of the employee's family, has a financial interest pertaining to the procurement;
- A business or organization in which the employee or any member of the employee's family, has a financial interest pertaining to the procurement; or
- Any other person, business, or organization with which the employee or any member of the employee's family is negotiating or has an arrangement concerning prospective employment is involved in the procurement.

Gratuities:
It shall be a breach of ethics for any person to offer, give, or agree to give any employee or former employee of Galveston County, or for any employee or former employee of Galveston County to solicit, demand, accept or agree to accept from another person, a gratuity or an offer of employment in connection with any decision, approval, disapproval, recommendation, preparation of any part of a program requirement or a purchase request, influencing the content of any specification or procurement standard, rendering of advice, investigation, auditing, or in any other advisory capacity in any proceeding or application, request for ruling, determination, claim or controversy, or other particular matter, pertaining to any program requirement or a contract or subcontract, or to any solicitation or bid pending before this government.

Kickbacks:

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It shall be a breach of ethics for any payment, gratuity or offer of employment to be made by or on behalf of a subcontractor under a contract to the prime contractor or higher tier subcontractor for any contract for Galveston County, or to any person associated therewith, as an inducement for the award of a contract, subcontract or order.

Contract Clause:
The prohibition against gratuities and kickbacks prescribed above shall be conspicuously set forth in every contract and solicitation by Galveston County.

Confidential Information:
It shall be a breach of ethics for any employee or former employee of Galveston County to knowingly use confidential information for actual or anticipated personal gain, or for the actual or anticipated gain of any other person.

Prohibition against Contingent Fees:
It shall be a breach of ethical standards for a person to be retained, or to retain a person, to solicit or secure a Galveston County contract upon an agreement or understanding for a commission, percentage, brokerage, or contingent fee, except for retention of bona fide employees or bona fide established commercial selling agencies for the purpose of securing business. Failure to abide by this section constitutes a breach of ethical standards.

Representation:
Proposer represents and warrants, by signing and submitting its proposal, that it has not retained anyone in violation of this section prohibiting contingent fees.

Contract Clause:
The representation prescribed above shall be conspicuously set forth in every contract and solicitation thereof.

55. NON-COLLUSION AFFIDAVIT
Proposer certifies, by signing and submitting a proposal , that the proposal is not made in the interest of, or on behalf of, any undisclosed person, partnership, company, association, organization, or corporation; that the proposal is genuine and not collusive or sham; that the contractor has not directly or indirectly induced or solicited another contractor to put in a false or sham proposal, and has not directly or indirectly colluded, conspired, connived, or agreed with any contractor or anyone else to put in a sham proposal or that anyone shall refrain from bidding; that the contractor has not in any manner, directly or indirectly, sought by agreement, communications, or conference with anyone to fix the bid price of the contractor of any other proposer, or to fix any overhead, profit or cost element of the proposal price, or that of any other contractor, or to secure any advantage against the public body awarding the contract or anyone interested in the proposed contract; that all statements contained in the proposal are true; and further, that the contractor has not, directly or indirectly, submitted his or her proposal price or any breakdown thereof, or the contents thereof, or divulged information or data relative thereto, or paid, and will not pay, any fee to any cooperation, partnership, company association, organization, bid depository, or to any member or agent thereof to effectuate a collusive or sham proposal.

A blank Non-Collusion Affidavit is included with this proposal packet. Proposer must enclose a truthful and fully executed original Non-Collusion Affidavit with the submission of its proposal. This is a mandatory requirement of this request for proposal. Failure to include the truthfully and fully executed Non-Collusion Affidavit in the submission of its proposal shall be considered non-compliance with the requirements of this request for proposal by the Proposer and grounds for the rejection of Proposer's submission.

No negotiations, decisions, or actions shall be initiated by any company as a result of any verbal discussion with any County employee prior to the opening of responses to this request for proposal.

No officer or employee of the County of Galveston, and no other public or elected official, or employee, who may exercise any function or responsibilities in the review or approval of this undertaking shall have any personal or

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financial interest, direct or indirect, in any contract or negotiation process thereof. The above compliance request will be part of all County of Galveston contracts for this service.

56. CERTIFICATION REGARDING LOBBYING

Proposer certifies that:

a. No Federal appropriated funds have been paid or will be paid, by or on behalf of the bidder, to any person for influencing or attempting to influence a department or employee of an agency, a member of Congress, or an employee of a member of Congress in connection with the awarding of any Federal contract, the making of any Federal grant, the making of any Federal loan, the entering into of any cooperative agreement, and the extension, continuation, renewal, amendment, or modification of any Federal contract, grant, loan or cooperative agreement.

b. If any funds other than federal appropriated funds have been paid or will be paid to any person for influencing or attempting to influence a department or employee of any agency, a member of Congress, a department or employee of congress, or an employee of a member of Congress in connection with this federal contract, grant, loan, or cooperative agreement, the bidder shall complete and submit Standard Form LLL, "Disclosure Form to Report Lobbying", in accordance with its instructions.

c. Proposer shall require that the language of this certification be included in the award documents for all subawards at all tiers (including subcontracts, subgrants, and contracts under grants, loans, and cooperative agreements) and that all subrecipients shall certify and disclose accordingly.

The truthful and fully completed and executed original of the Certification Regarding Lobbying (included with bid packet) must be included with the submission of proposer's proposal and is a mandatory requirement of this request for proposal. Proposer's failure to include the fully completed and executed or original of this Certification shall be considered non-compliant with the requirements of this request for proposal and grounds for the rejection of the Proposer's proposal. Submission of the certification is a prerequisite for making or entering into a contract with Proposer and is imposed by Section 1352, Title 31, United States Code. Further, any person who fails to file the required certification shall be subject to a civil penalty of not less than $10,000 and not more than $100,000 for each such failure.

57. NON-DISCRIMINATION

a. **Equal Employment Opportunity:** Proposer will not discriminate against any employee or applicant for employment because of race, color, religion, national origin, sex, disability, genetic information or veteran status. Proposer will take affirmative action to ensure that applicants are employed, and that employees are treated during employment, without regard to their race, color, religion, national origin, sex, disability, genetic information or veteran status. Such action shall include, but not be limited to, the following: employment; upgrading; demotion or transfer; recruitment or recruitment advertising; layoff or termination; rates of pay or other forms of compensation; and selection for training, including apprenticeship. Proposer agrees to post in conspicuous places, available to employees and applicants for employment, notices of employment.

Proposer will, in all solicitation or advertisements for employees placed by or on behalf of proposer, state that all qualified applicants will receive consideration for employment without regard to race, color, religion, national origin, sex, disability, genetic information, or veteran status.

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Proposer will cause the foregoing provisions to be inserted in all subcontracts for any work covered by this Agreement so that such provisions will be binding upon each subcontractor, provided that the foregoing provisions shall not apply to contracts or subcontracts for standard commercial supplies or raw materials.

Proposer will include the provisions herein in every subcontract or purchase order unless exempted.

b. Drug Free Work Place Act: Proposer shall comply with all applicable requirements of the Drug-Free Workplace Act of 1988 (Public Law 100-690, Title V, Subtitle D; 41 U.S.C. § 8102, et seq.) and implementing regulations thereunder.

c. Americans with Disabilities Act: Proposer shall comply with all applicable provisions of the Americans with Disabilities Act of 1990 (Public Law 101-136) and implementing regulations thereunder.

d. OSHA Regulations: Proposer agrees to maintain and to display any applicable materials for its employees in accordance with OSHA regulations.

e. Compliance with Immigration Laws and Use of E-Verify: Proposer agrees to comply with all requirements of the U.S. Immigration Reform and Control Act of 1986, as amended, and any implementing regulations thereto. Proposer further agrees to utilize the E-Verify system through the Department of Homeland Security on its employees. Proposer shall not employ unauthorized aliens, and shall not assign services to be performed to any supplier or subcontractor who are unauthorized aliens. If any personnel performing any services hereunder are discovered to be an unauthorized alien, then Proposer will immediately remove such personnel from performing services hereunder and shall replace such personnel with personnel who are not unauthorized alien(s).

f. State and Federal Law Compliance: Proposer agrees to comply with all other State and Federal laws and regulations applicable to the provision of services under this contract.

58. RECORD RETENTION AND RIGHT TO AUDIT

Proposer shall keep and maintain all records associated with this contract for a minimum of five (5) years from the close of the contract or as required by Federal or State law or regulation, whichever period is longer. If awarded this contract, proposer shall allow the County reasonable access to the records in proposer's possession, custody, or control that the County deems necessary to assist it in auditing the services, costs, and payments provided hereunder. If this contract involves the use of Federal or State funds, then proposer shall also allow reasonable access to representatives of the Office of Inspector General, the General Accounting Office, the State Auditor's Office, and the other Federal and/or State agencies overseeing the funds that such entities deem necessary to facilitate review by such agencies and proposer shall maintain fiscal records and supporting documentation for all expenditures in a manner that conforms with OMB Circular A-87 (relocated to 2 C.F.R. Part 225) and this contract.

59. TITLE VI ASSURANCES/TxDOT

The County is subject to Title VI of the Civil Rights Act of 1964 and the Federal and State laws and regulations of the United States Department of Transportation and Texas Department of Transportation (TxDOT). Pursuant to these requirements, the County must have its contractors provide required assurances on compliance with non-discrimination by itself and its subcontractors. The Title VI Assurances within this Subsection are not exhaustive – whenever any Federal, State, or Local requirement requires additional clauses, this list shall not be construed as limiting. Contractor agrees as follows:

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(1) **Compliance with Regulations**: The Contractor shall comply with the Regulations relative to nondiscrimination in Federally-assisted programs of the Department of Transportation (hereinafter, DOT) Title 49, Code of Federal Regulations, Part 21, as they may be amended from time to time (hereinafter referred to as the Regulations), which are incorporated herein by reference and made a part of this contract.

(2) **Non-discrimination**: The Contractor, with regard to the work performed by it during the contract, shall not discriminate on the basis of race, color, national origin, religion, sex, age, disability or Veteran status in the selection and retention of subcontractors, including procurements of materials and leases of equipment. The Contractor shall not participate either directly or indirectly in the discrimination prohibited by Section 21.5 of the Regulations, including employment practices when the contract covers a program set forth in Appendix B of the Regulations.

(3) **Solicitations for Subcontractors, Including Procurement of Materials and Equipment**: In all solicitations either by competitive bidding or negotiation made by the Contractor for work to be performed under a subcontract, including procurement of materials or leases of equipment, each potential subcontractor or supplier shall be notified by the Contractor of the Contractor's obligations under this contract and the Regulations relative to nondiscrimination on the grounds of race, color, national origin, religion, sex, age, disability or Veteran status.

(4) **Information and Reports**: The Contractor shall provide all information and reports required by the Regulations or directives issued pursuant thereto, and shall permit access to its books, records, accounts, other sources of information and its facilities as may be determined by the Galveston County or the Texas Department of Transportation to be pertinent to ascertain compliance with such Regulations, orders and instructions. Where any information required of the Contractor is in the exclusive possession of another who fails or refuses to furnish this information the Contractor shall so certify to Galveston County or the Texas Department of Transportation as appropriate, and shall set forth what efforts it has made to obtain the information.

(5) **Sanctions for Non-compliance**: In the event of the Contractor's noncompliance with the nondiscrimination provisions of this contract, Galveston County shall impose such contract sanctions as it or the Texas Department of Transportation may determine to be appropriate, including, but not limited to:

(a) withholding of payments to the Contractor under the contract until the Contractor complies, and/or;
(b) cancellation, termination, or suspension of the contract, in whole or in part.

(6) **Incorporation of Provisions**. The Contractor shall include the provisions of paragraphs (1) through (6) in every subcontract, including procurement of materials and leases of equipment, unless exempt by the Regulations, or directives issued pursuant thereto. The Contractor shall take such action with respect to any subcontract or procurement as Galveston County or the Texas Department of Transportation may direct as a means of enforcing such provisions including sanctions for non-compliance: Provided, however, that, in the event Contractor becomes involved in, or is threatened with, litigation with a subcontractor or supplier as a result of such direction, the Contractor may request Galveston County to enter into such litigation to protect the interests of Galveston County, and, in addition, the Contractor may request the United States to enter into such litigation to protect the interests of the United States.

60. SECTION 231.006, FAMILY CODE/DELINQUENT CHILD SUPPORT

Pursuant to Title 5, Section 231.006 of the Texas Family Code, as applicable, Proposer certifies that it, including all of its principals, is/are current in child support payments and that it is eligible to receive payments from State funds under a contract for property, materials, or services. Proposer acknowledges and agrees that if it is awarded this contract, then the ensuing agreement may be terminated and payment withheld if this certification is inaccurate. Finally, by the submission of its proposal, the Proposer certifies that it has included the names and social security

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numbers of each person with at least 25% ownership interest in Proposer within its response to the request for proposal and that all such persons are current in child support payments.

61. ANTITRUST

Pursuant to 15 U.S.C. § 1, et seq., and Texas Business and Commerce Code, Chapter 15, Contractor, by the submission of its proposal, certifies that neither Contractor nor any natural person, proprietorship, firm, corporation, partnership, association, or institution represented by Contractor or anyone acting for such natural person, proprietorship, firm, corporation, partnership, association, or institution has violated any Federal or State antitrust laws or communicated the nature of the offer, directly or indirectly, to any competitor or other person engaged in a similar line of business.

62. LABOR STANDARDS

On contracts funded under a federal grant: Proposer acknowledges that the contract to be awarded pursuant to this solicitation is on a grant program funded with Federal funds. Proposer shall comply with the requirements of 29 CFR Part 5 and Part 30 and shall be in conformity with Executive Order 11246, entitled "Equal Employment Opportunity", Copeland, "Anti-Kickback" Act (40 U.S.C. 3145, 29 C.F.R. Part 3), the Davis-Bacon and Related Acts (40 U.S.C. 3141-3148, 29 C.F.R. Parts 1,3, and 5), the Contract Work Hours and Safety Standards Act (40 U.S.C. 3701 et seq.), and all other applicable Federal, State, and local laws and regulations pertaining to labor standards, insofar as those acts apply to the performance of this Agreement. Proposer is also responsible for ensuring that all subcontractors comply with the requirements of 29 CFR Part 5 and Part 30 and shall be in conformity with Executive Order 11246, entitled "Equal Employment Opportunity", Copeland "Anti-Kickback" Act, the Davis-Bacon and Related Acts (29 CFR Parts 1, 3 and 5), the Contract Work Hours and Safety Standards Act (40 U.S.C. 3701 et seq.), and all other applicable Federal, State, and local laws and regulations pertaining to labor standards, insofar as those acts apply to the performance of this Agreement.

63. PROCUREMENT LAWS

a. Proposer shall comply with all applicable local, State, and Federal laws, rules, and regulations.

b. If this contract is made pursuant to a federal award, then Contractor acknowledges that the contract is subject, without limitation, to applicable provisions within 2 C.F.R. Part 200, Uniform Administrative Requirements, Cost Principles, and Audit Requirements for Federal Awards. Contractor shall comply with applicable provisions within 2 C.F.R., Sections 200.319 through 200.326, including but not limited to the following:

1.) **Equal Employment Opportunity**, 41 C.F.R. Part 60-1.4(b) (applicable to federally assisted construction contracts).

(a) During the performance of this contract, the contractor agrees as follows:

(1) The contractor will not discriminate against any employee or applicant for employment because of race, color, religion, sex, national original, disability, or veteran status. The contractor will take affirmative action to ensure that applicants are employed, and that employees are treated during employment, without regard to their race, color, religion, sex, national original, disability or veteran status. Such action shall include, but not be limited to the following: employment, upgrading, demotion, or transfer; recruitment or recruitment advertising; layoff or termination; rates of pay or other forms of compensation; and selection for training, including apprenticeship. The contractor agrees to post in conspicuous places, available to employees and applicants for employment, notices to be provided setting forth the provisions of this nondiscrimination clause.

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(2) The contractor will, in all solicitations or advertisements for employees placed by or on behalf of contractor, state that all qualified applicants will receive consideration for employment without regard to race, color, religion, sex, national original, disability, or veteran status.

(3) The contractor will send to each labor union or representative of workers with which he has a collective bargaining agreement or other contract or understanding, a notice to be provided advising the said labor union or workers' representatives of the contractor's commitments under this section, and shall post copies of the notice in conspicuous places available to employees and applicants for employment.

(4) The contractor will comply with all provisions of Executive Order 11246 of September 24, 1965, and by rules, regulations, and relevant orders of the Secretary of Labor.

(5) The contractor will furnish all information and reports required by Executive Order 11246 of September 24, 1965, and by rules, regulations, and orders of the Secretary of Labor, or pursuant thereto, and will permit access to contractor's books, records, and accounts by the administering agency and the Secretary of Labor for purposes of investigation to ascertain compliance with such rules, regulations, and orders.

(6) In the event of the contractor's noncompliance with the nondiscrimination clauses of this contract or with any of the said rules, regulations, or orders, this contract may be cancelled, terminated, or suspended in whole or in part and the contractor may be declared ineligible for further Government contracts or federally assisted construction contracts in accordance with procedures authorized in Executive Order 11246 of September 24, 1965, and such other sanctions as may be imposed and remedies invoked as provided in Executive Order 11246 of September 24, 1965, or by rule, regulation, or order of the Secretary of Labor, or as otherwise provided by law.

(7) The contractor will include the portion of the sentence immediately preceding paragraph (1) and the provisions of paragraphs (1) through (7) in every subcontract or purchase order unless exempted by rules, regulations, or orders of the Secretary of Labor issued pursuant to section 204 of Executive Order 11246 of September 24, 1965, so that such provisions will be binding upon each subcontractor or vendor. The contractor will take such action with respect to any subcontract or purchase order as the administering agency may direct as a means of enforcing such provisions, including sanctions for noncompliance: Provided, however, that in the event a contractor becomes involved in, or is threatened with, litigation with a subcontractor or vendor as a result of such direction by the administering agency, the contractor may request the United States to enter into such litigation to protect the interests of the United States.

2.) **Small and minority business, women's business enterprises, and labor surplus area firms (2 C.F.R. § 200.321).** The County is required to take affirmative steps to assure that minority businesses, women's business enterprises, and labor surplus area firms are used when possible. This includes requiring the prime contractor, if subcontracts are to be let in the performance of this contract, to itself take affirmative steps in letting the subcontract. Accordingly, if subcontracts are to be let in the performance of this contract, the contractor must take affirmative steps in the letting of the subcontract(s), which must include:

(a) placing qualified small and minority businesses and women's business enterprises on solicitation lists;
(b) assuring that small and minority businesses, and women's business enterprises are solicited whenever they are potential sources;
(c) dividing total requirements, when economically feasible, into smaller tasks or quantities to permit maximum participation by small and minority businesses, and women's business enterprises; and
(d) using the services and assistance, as appropriate, of such organizations as the Small Business Administration and the Minority Business Development Agency of the Department of Commerce.

In accordance with FEMA procurement guidance:

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A small business is a business that is independently owned and operated, not dominant in the field of operation in which it is bidding on Galveston County contracts, and qualified as a small business under the Small Business Administration criteria and size standards at 13 C.F.R. Part 121.

A women's business enterprise is a business enterprise that is: (a) at least 51 percent owned by one or more women or, in the case of a publicly owned business, at least 51 percent of the stock is owned by one or more women; and (b) whose management and daily operations are controlled by one or more women.

A minority business is a business that is (a) at least 51 percent owned by one or more minority group members or, in the case of a publicly owned business, at least 51 percent of the stock is owned by one or more minority group members; and (b) whose management and daily operations are controlled by one or more minority group members.

3.) **Davis-Bacon Act as amended (40 U.S.C. 3141-3148).** When required by Federal program legislation, all prime construction contracts in excess of $2,000 must include a provision for compliance with the Davis-Bacon Act as supplemented by the Department of Labor regulations (29 C.F.R. Part 5, "Labor Standards Provisions Applicable to Contracts Covering Federally Financed and Assisted Construction"). In accordance with the statute, contractor must be required to pay wages to laborers and mechanics at a rate not less than the prevailing wages specified in a wage determination made by the Secretary of Labor. In addition, contractors must be required to pay wages not less than once a week. The non-Federal entity (the County) must place a copy of the current prevailing wage determination issued by the Department of Labor in each solicitation. The decision to award a contract or subcontract must be condition upon the acceptance of the wage determination. The non-Federal entity must report all suspected or reported violations to the Federal awarding agency. The contract must also include a provision for compliance with the Copeland Anti-Kickback Act (40 U.S.C. § 3145) as supplemented by the Department of Labor regulations (29 C.F.R. Part 3, "Contractors and Subcontractors on Public Building or Public Work Financed in Whole or in Part by Loans or Grants from the United States").

4.) **Compliance with the Copeland "Anti-Kickback" Act.** Contractor is prohibited from inducing, by any means, any person employed in the construction, completion, or repair of public work, to give up any part of the compensation to which the person is otherwise entitled. The non-Federal entity must report all suspected or reported violations to the Federal awarding agency. "Whoever, by force, intimidation, or threat of procuring dismissal from employment, or by any other manner whatsoever induces any person employed in the construction, prosecution, completion or repair of any public building, public work, or building or work financed in whole or in part by loans or grants from the United States, to give up any part of the compensation to which he is entitled under his contract of employment, shall be fined under this title [Title 18, U.S.C.] or imprisoned not more than five years, or both." 18 U.S.C. § 874.

(a) Contractor shall comply with 18 U.S.C. § 874, 40 U.S.C. § 3145, and the requirements of 29 C.F.R. Part 3 as may be applicable, which are incorporated by reference into this contract.

(b) The contractor or subcontractor shall insert in any subcontracts the clause above and such other clauses as the Federal awarding agency may be appropriate instructions require, and also a clause requiring the subcontractors to include these clauses in any lower tier subcontracts. The prime contractor shall be responsible for the compliance by any subcontractor or lower tier subcontractor with all of these contract clauses.

(c) Breach. A breach of the contract clause above may be grounds for termination of the contract, and for debarment as a contractor and subcontractor as provided in 29 C.F.R. § 5.12.

5.) **Contract Work Hours and Safety Standards Act.**

(a) Where applicable, all contracts awarded by the County in excess of $100,000 that involve the employment of mechanics or laborers must include a provision for compliance with 40 U.S.C. §§ 3702 and 3704, as

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supplemented by the Department of Labor regulations at 29 C.F.R. Part 5. Under 40 U.S.C. § 3702 of the Contract Work Hours and Safety Standards Act, each contractor must be required to compute the wages of every mechanic and laborer on the basis of a standard work week of 40 hours. Work in excess of the standard work week is permissible provided that the worker is compensated at a rate of not less than one and a half times the basic rate of pay for all hours worked in excess of 40 hours in the work week. The requirements of 40 U.S.S. 3704 are applicable to construction work and provide that no laborer or mechanic must be required to work in surroundings or under working conditions which are unsanitary, hazardous or dangerous. These requirements do not apply to the purchase of supplies or material or articles ordinarily available on the open market, or contractors for transportation or transmission of intelligence.

(b) Compliance with the Contract Work Hours and Safety Standards Act.

(1) Overtime requirements. No contractor or subcontractor contracting for any part of the contract work which may require or involve the employment of laborers or mechanics shall require or permit any such laborer or mechanic in any workweek in which he or she is employed on such work to work in excess of forty hours in such workweek unless such laborer or mechanic receives compensation at a rate not less than one and one-half times the basic rate of pay for all hours worked in excess of forty hours in such workweek.

(2) Violation; liability for unpaid wages; liquidated damages. In the event of any violation of the clause set forth in paragraph (1) of this subsection the contractor and any subcontractor responsible therefor shall be liable for the unpaid wages. In addition, such contractor and subcontractor shall be liable to the United States (in the case of work done under contract for the District of Columbia or a territory, to such District or to such territory), for liquidated damages. Such liquidated damages shall be computed with respect to each individual laborer or mechanic, including watchmen and guards, employed in violation of the clause set forth in paragraph (1) of this subsection, in the sum of $10 for each calendar day on which such individual was required or permitted to work in excess of the standard work week of forty hours without payment of the overtime wages required by the clause set forth in paragraph (1) of this subsection.

(3) Withholding for unpaid wages and liquidated damages. The awarding Federal agency, State agency, or the County shall upon its own action or upon written request of an authorized representative of the Department of Labor withhold or cause to be withheld, from any moneys payable on account of work performed by the contractor or subcontractor under any such contract or any other Federal contract with the same prime contractor, or any other federally-assisted contract subject to the Contract Work Hours and Safety Standards Act, which is held by the same prime contractor, such sums as may be determined to be necessary to satisfy any liabilities of such contractor or subcontractor for unpaid wages and liquidated damages as provided in the clause set forth in paragraph (2) of this subsection.

(4) Subcontracts. The contractor or subcontractor shall insert in any subcontracts the clauses set forth in paragraph (1) through (4) of this subsection and also a clause requiring the subcontractors to include these clauses in any lower tier subcontracts. The prime contractor shall be responsible for compliance by any subcontractor or lower tier subcontractor with the clauses set forth in paragraphs (1) through (4) of this subsection.

6.) **Rights to Inventions Made Under a Contractor Agreement.**

(a) If the Federal award meets the definition of "funding agreement" under 37 C.F.R. § 401.2(a) and the recipient or subrecipient wishes to enter into a contract with a small business firm or nonprofit organization regarding the substitution of parties, assignment or performance of experimental, developmental, or research work under the "funding agreement," the recipient or subrecipient must comply with the requirements of 37 C.F.R. Part 401, "Rights to Inventions Made by Nonprofit Organizations and Small Business Firms Under Government Grants, Contracts and Cooperative Agreements," and any implementing regulations issued by the awarding agency.

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(b) Stafford Act Disaster Grants. This requirement does not apply to Public Assistance, Hazard Mitigation Grant Program, Crisis Counseling Assistance and Training Grant program, Disaster Case Management Grant Program, and Federal Assistance to Individuals and Households – Other Needs Assistance Grant Program, as FEMA awards under these programs do not meet the definition of "funding agreement."

(c) The regulations and 37 C.F.R. § 401.2(a) currently defines "funding agreement" as any contract, grant, or cooperative agreement entered into between any Federal agency, other than the Tennessee Valley Authority, and any contractor for the performance of experimental, developmental, or research work funded in whole or in part by the Federal government. This term also includes any assignment, substitution of parties, or subcontract of any type entered into for the performance of experimental, developmental, or research work under a funding agreement as defined in the first sentence of this paragraph.

7.) **Clean Air Act (42 U.S.C. §§ 7401 – 7671q) and the Federal Water Pollution Control Act 933 U.S.C. §§ 1251-1387), as amended.**

(a) The contractor agrees to comply with all applicable standards, orders or regulations issued pursuant to the Clean Air Act, as amended, 42 U.S.C. § 7401, et seq., and agrees to comply with all applicable standards, orders, or regulations issued pursuant to the Federal Water Pollution Contract Act, as amended, 33 U.S. C. § 1251, et seq.

(b) The contractor agrees to report each violation of the Clean Air Act and/or the Federal Water Pollution Control Act to the Federal awarding agency, the State agency administering the grant, and the Regional Office of the Environmental Protection Agency (EPA) and understands and agrees that the Federal awarding agency, the State agency, and the EPA will, in turn, report each violation as required to assure notification to Galveston County, the Federal Emergency Management Agency, and the appropriate EPA Regional Office.

8.) **Debarment and Suspension (Executive Orders 12549 and12689).** A contract award must not be made to parties listed on the government-wide exclusions in the System for Award Management (SAM), in accordance with the OMB guidelines at 2 C.F.R. Part 180 that implement Executive Orders 12549 and 12689. The Contractor is required to verify that none of the contractor, its principals (defined at 2 C.F.R. § 180.995), or its affiliates (defined at 2 C.F.R. § 180.905) are excluded (defined at 2 C.F.R. §180.940) or disqualified (defined at 2 C.F.R. § 180.935).

Contractor must comply with 2 C.F.R. Part 180, Subpart C and 2 C.F.R. Part 3000, Subpart C, and must include a requirement to comply with these regulations in any lower tier covered transaction it enters into. Proposer agrees to comply with the requirements of 2 C.F.R. Part 180, Subpart C, and 2 C.F.R. Part 3000, Subpart C, while this offer is valid and through the period of any contract that may arise from this offer. The proposer further agrees to include a provision requiring such compliance in its lower tier covered transactions.

9.) **Procurement of Recovered Materials.**

(a.) A non-Federal entity that is a State agency or agency of a political subdivision of the State and its contractors must comply with Section 6002 of the Solid Waste Disposal Act, Public Law No. 89-272 (1965) (codified as amended by the Resource Conservation and Recovery Act at 42 U.S.C. § 6962).

(b.) In the performance of this contract, the contractor shall make maximum use of products containing recovered materials that are EPA-designated items unless the product cannot be acquired—

(1) Competitively within a timeframe providing for compliance with the contract performance schedule;

(2) Meeting contract performance requirements; or

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(3) At a reasonable price.

(c) Information about this requirement is available at EPA's Comprehensive Procurement Guidelines website, http://www.epa.gov/cpg/. The list of EPA-designated items is available at https://www.epa.gov/cpg/products.htm.

In the event of any discrepancy between the provisions in this Section 63 of General Provisions and provisions on the same subject elsewhere within this procurement, the most stringent shall control.

64. ENTIRETY OF AGREEMENT AND MODIFICATION

This contract contains the entire agreement between the parties. Any prior agreement, promise, negotiation or representation not expressly set forth in this contract has no force or effect. Any subsequent modification to this contract must be in writing, signed by both parties.

An official representative, employee, or agent of the County does not have the authority to modify or amend this contract except pursuant to specific authority to do so granted by the Galveston County Commissioners Court.

65. NOTICE

All notices or other communications required or permitted under this contract shall be in writing and shall be deemed to have been duly given if delivered personally in hand, transmitted by facsimile, or mailed certified mail, return receipt requested with proper postage affixed and addressed to the appropriate party at the following address or at such other address as may have been previously given in writing to the parties (proposer shall provide its notice information with its proposal submission). If mailed, the notice shall be deemed delivered when actually received, or if earlier, on the third day following deposit in a United States Postal Service post office or receptacle, duly certified, return receipt requested, with proper postage affixed. If delivered in person, notice shall be deemed delivered when receipted for by, or actually received by, the receiving Party. If transmitted by facsimile, notice shall be deemed delivered when receipt of such transmission is acknowledged.

To the County at:

Hon. Mark Henry,
County Judge of Galveston County
722 Moody (21st Street), Second (2nd) Floor
Galveston, Texas 77550
Fax: (409) 765-2653

With copies to:

Rufus Crowder, CPPO CPPB,
Galveston County Purchasing Agent
722 Moody (21st Street), Fifth (5th) Floor
Galveston, Texas 77550
Fax: (409) 621-7997

To the Contractor at:

(Proposer to provide its contact name, address, and facsimile number for notice under the contract.)

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66. USE OF DHS SEAL, LOGO, AND FLAGS PROHIBITED WITHOUT PRIOR APROVAL
Contractor must obtain permission from the U.S. Department of Homeland Security financial assistance office (DHS FAO) **prior** to using DHS seals(s), logos, crests, or reproductions of flags or likenesses of DHS agency officials, including use of the United States Coast Guard seal, logo, crests or reproductions of flags or likenesses of Coast Guard Officials.

67. FEDERAL GOVERNMENT NOT A PARTY
Contractor acknowledges that the Federal Government is not a party to the contract and is not subject to any obligations or liabilities to Galveston County, contractor, or any other party pertaining to any matter resulting from the contract.

68. PROGRAM FRAUD AND FALSE OR FRAUDULENT STATEMENTS OR RELATED ACTS
In contracts funded through Federal grants, Contractor acknowledges that 31 U.S.C. Chapter 38, Administrative Remedies for False Claims and Statements (31 U.S.C. § 3801, et seq.) and the implementing regulations thereunder, 49 C.F.R. Part 79, apply to Contractors actions pertaining to the contract.

69. LEAD AND ASBESTOS
If this request for proposal involves remediation, demolition, reconstruction, rehabilitation, repair, or construction, or other applicable activities, the Contractor shall be responsible for performing investigations of lead and asbestos containing materials, and any required lead and asbestos abatement in compliance with Federal, State, and local laws, rules, regulations, ordinances and orders, relating to lead abatement and asbestos abatement as applicable, including but not limited to the Texas Asbestos Health Protection Act, codified as Chapter 1954 of the Occupations Code; the Texas Asbestos Health Protection Regulations, located at Title 25, Part 1, Chapter 295, Subchapter C of the Texas Administrative Code; Chapter 1955 of the Texas Occupations Code (lead-based paint abatement); the Texas Environmental Lead Reduction regulations, located at Title 25, Part 1, Chapter 295, Subchapter I of the Texas Administrative Code; the federal National Emission Standards for Asbestos regulations, located at Title 40, Part 61, Subpart M of the Code of Federal Regulations, and the National Emission Standards for Hazardous Air Pollutants. Contractor shall perform such inspections, encapsulation, remediation or other actions as required by federal, State, or local requirements in accordance with the federal Environmental Protection Agency (EPA), Texas Department of State Health Services (TXDSHS), and Texas Commission on Environmental Quality (TCEQ) requirements.

70. ACKNOWLEDGMENT OF GOVERNMENT RECORD
Proposer acknowledges that its submission in this Request for Proposals, including its Proposal, certifications, affidavits, Vendor Forms (i.e., PEID, W-9, CIQ, etc.) constitutes government records under Chapter 37 of the Texas Penal Code.

71. COMPLIANCE WITH GALVESTON COUNTY PURCHASING POLICIES AND PROCEDURES
Proposer acknowledges, by its submission in this Request for Proposals, that it shall comply with the Galveston County Purchasing Policies & Procedures Manual approved by Order of the Galveston County Commissioners Court on March 7, 2018.

End of General Provisions Section

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RFP #B201044
OPEN: 10/15/2020
TIME: 2:15 P.M.

SPECIAL PROVISIONS
GALVESTON COUNTY ROAD & BRIDGE FACILITY REBUILD PROJECT
GALVESTON COUNTY, TEXAS

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RFP #B201044
OPEN: 10/15/2020
TIME: 2:15 P.M.

REQUEST FOR PROPOSALS
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SPECIAL PROVISIONS

The Special Provisions and the General Provisions of this Request for Proposal and the Exhibits attached hereto are made a part of the agreement between the Parties. In the event of a conflict between the General Provisions and the Special Provisions, the terms of the Special Provisions shall control.

A. PURPOSE:

Galveston County issues this ***competitive sealed proposal*** in an effort to acquire a general contractor to perform construction services to include new buildings and site work at the following location:

Galveston County Road and Bridge Deparatment
511 TX-3
Dickinson, TX 77539

The new facility scope includes the following:

- Administrative office;
- Fleet maintenance shop;
- Fueling facility;
- Wash rack;
- Parking for vehicles and equipment;
- Work at the department's currently occupied site;
- Work on an adjacent vacant site to the south of the occupied site;
- Sitework and the construction of multiple new structures as described in the drawings and specifications.

The department will continue to operate in its exising buildings during the phased construction process as described in the drawings and related documents.

Proposers should reference all technical specification sections of this document for the detailed Scope of Work requested for this construction project.

The award shall be made to the proposer that meets or exceeds the requested specifications and is the highest rated offeror that submits the best valued competitive proposal based on the listed evaluation criteria.

B. DEFINITIONS (As mentioned in FAR Subpart 52.2—Text of Provisions and Clauses)

52.202-1 Definitions.

Definitions (Nov 2013)

When a solicitation provision or contract clause uses a word or term that is defined in the Federal Acquisition Regulation (FAR), the word or term has the same meaning as the definition in FAR 2.101 in effect at the time the solicitation was issued, unless—

(a) The solicitation, or amended solicitation, provides a different definition;
(b) The contracting parties agree to a different definition;
(c) The part, subpart, or section of the FAR where the provision or clause is prescribed provides a different meaning; or
(d) The word or term is defined in FAR Part 31, for use in the cost principles and procedures

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C. BID/PROPOSAL SURETY:
A 5% surety bond ***is a requirement of this solicitation***.

D. PERFORMANCE AND PAYMENT BONDS
100% Performance and Payment Bonds ***are a requirement of this solicitation***.

E. BEST AND FINAL OFFERS (BAFO):
The Best and Final Offer process *is applicable to this solicitation.*

F. DAVIS-BACON WAGE RAGES
Attention is called to the fact that not less than, the federally determined prevailing (Davis-Bacon and Related Acts) wage rate, as issued by the Office of Rural Community Affairs and contained in the contract documents, must be paid on this project. In addition, the successful bidder must ensure that employees and applicants for employment are not discriminated against because of race, color, religion, sex age or national origin.

G. PROCUREMENT TIMELINE:
A timeline for this RFP and initial process is included below. Galveston County reserves the right to amend these dates and will notify proposers of any changes via an addendum:

Advertise RFP (first date of publication)	**Friday September 4, 2020**
Advertise RFP (second date of publication)	**Friday, September 11, 2020**
Pre-Proposal Meeting	**Thursday, September 17, 2020 at 10:00 a.m.**
Deadline for Questions & Inquiries	**Thursday, September 24, 2020 by 5:00 p.m.**
Proposals due from proposers/RFP Opening	**Thursday, October 15, 2020 at 2:15 p.m.**

H. SUBMISSION INSTRUCTIONS:
One (1) unbound original and three (3) copies must be submitted no later than **2:15 P.M. CST,** on **Thursday, October 15, 2020:**

Rufus G. Crowder, CPPO CPPB
Purchasing Agent
County of Galveston
722 Moody Avenue (21st Street), Fifth (5th) Floor
Galveston, TX 77550

The time stamp clock located in the Purchasing Agent's office shall serve as the official time keeping piece for this solicitation process. Any proposals received after **2:15 P.M. CST** on the specified date will be returned unopened.

Proposal Specifications can be obtained at the office of the Galveston County Purchasing Agent, located in the Galveston County Courthouse, 722 Moody, (21st Street), Floor 5, Purchasing, Galveston, Texas 77550, or by visiting the Galveston County website @
http://www.galvestoncountytx.gov/pu/Pages/BidListing.aspx

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I. PRE-PROPOSAL CONFERENCE:

A non-mandatory pre-proposal conference will be held on Thursday, September 17, 2020 at 10:00 a.m.

Due to the COVID-19 pandemic, the County of Galveston has instituted measures to guard against the spread of the virus. This includes the prohibition of in-person meetings, social distancing, and stay-at-home requirements for employees.

The Pre-Proposal Conference shall take place via video/tele-conference and the instructions are listed below and on the County's Purchasing website:

Minimum System Requirements for Video Conferencing:
1. High-resolution webcam;
2. Computer processing minimum: 2 GB of RAM and a quad-core processor;
3. Network bandwidth: 1 Mbps is sufficient for 15 fps at 720p resolution;

Calling from a mobile device:
1. Front facing camera;
2. In ear headphone with built in mic

Instructions for Video Conferencing:
1. Click here or navigate to https://guest.lifesize.com/1907077
2. Enter Name and email (optional);
3. Click the Terms of Service and Privacy Policy checkbox;
4. Click Join Meeting
   *Note - be sure to enable audio and video.

J. TYPE OF CONTRACT:

It is the intent of this solicitation to enter into a contract that meets federal guidelines. It is imperative that all responders seeking a contract under this RFP solicitation effort must familiarize and adhere to the procurement standards as referenced in 2 C.F.R. Part 200, Sections 200.317-200.326, and Appendix II, 2 C.F.R. Part 200. Sections 200.317–200.326 and Appendix II are attached hereto as **Exhibit A.**

The resultant contract consists of the following documents: Request for Proposal, General Provisions, Special Provisions, General Terms and Conditions (including specifications, drawings, and addenda), Responder's response, Proposal Sheets, contract award, and any other documents referenced herein or attached hereto for the work.

In an effort to satisfy cost reasonableness responsibilities, the County of Galveston reserves the right to obtain additional quotes and current pricing information from the successful contractor and other contractors to perform the work as stated per the specification listed herein and in the resultant contract. The solicited results may be used by the County to determine if the contract extensions or amendments will be considered or other service options be utilized.

K. COLLATERAL CONTRACT:

The County reserves the right to provide by separate contract or otherwise, in such manner as not to delay its programs or damage said Contractor, all labor and material essential to the completion of the work that is not included in this contract.

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L. AWARD PRICE:

Award prices include all royalties and costs arising from patents, trademarks, and copyrights in any way involved in the work. Whenever the Awardee is required or desires to use any design, device, material or process covered by letters of patent or copyright, the Awardee shall indemnify and save harmless the County, its officers, agents and employees from any and all claims for infringement by reason of the use of any such patented design, tool, material, equipment, or process, to be performed under the contract, and shall indemnify the County its officers, agents, and employees for any costs, expenses and damages which may be incurred by reason of any infringement at any time during the prosecution or after the completion of the work.

M. INVOICES AND PAYMENT:

Invoices for services rendered under this contract shall be prepared monthly and rendered for payment to the County of Galveston's Auditing Department in the month following the month within which the services were received. All invoices must have a Purchase Order Number listed on the invoice to be prepared properly processed. The County Auditor's address is as follows:

Galveston County Auditing Department
Attn: Accounts Payable
P.O. box 1418
Galveston, Texas 77553

N. PERSONNEL TO CONTACT REGARDING THIS SOLICITATION:

Proposers desiring an explanation or interpretation relative to this solicitation must request it in writing. Oral explanations or instructions will not be binding. Any information given to a Proposer, which in the opinion of the County affects all responders or would be prejudicial to other proposers if not communicated, shall be furnished to all proposers as an addendum to the solicitation. Proposers **must** direct all inquiries to the following:

Rufus G. Crowder, CPPO CPPB
Purchasing Agent
722 21st Street (Moody), 5th Floor
Galveston, Texas 77550
E-mail: purchasing.bids@co.galveston.tx.us

Proposers must e-mail their inquiries (with the subject line **"Galveston County Road & Bridge Facility Rebuild Project– RFP #B201044 – Questions"**) for additional information and/or clarification to the address listed above. The request must include the Proposer's name and the RFP number and title. ***Any request for additional information or clarification must be received in writing no later than seven (7) calendar days prior to the proposals due date.*** Late requests or those not delivered to the proper address may not receive a reply. Proposers shall not attempt to contact the County by any other means. The Purchasing Agent's Office shall post the answers to the County website from the procurement web page and via addendum.

The County will issue responses to inquiries and any other corrections or amendments, it deems necessary, in the form of a written addendum, issued prior to the Proposal Submission Date. The County, at its sole discretion, may not issue a response to a RFI submittal. Proposers should not rely on any oral or written representations, statements, or explanations, other than those made in this RFP or in any written addendum to this RFP. Where there appears to be conflict between the RFP and any issued addenda, the last

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addendum issued will prevail. Addenda will be posted and made available on the County's procurement web page. It is Proposer's sole responsibility to ensure receipt of all addenda prior to submitting its proposal. All Proposers should check the County's procurement web page for all addenda prior to submitting a response. The County's procurement web page is located at **www.galvestoncountytx.gov/pu/Pages/BidListing.aspx.**

The Proposer must acknowledge the receipt of all addenda on the forms provided. In the event a Proposer fails to acknowledge receipt of such addenda, the County may, at its sole discretion, determines that such failure to acknowledge any or all addenda does not materially affect the Proposal and waive the acknowledgement of one or more addenda.

Proposers who submit inquiries *after* the deadline date for receipt of questions indicated on the Procurement Timeline, risk that its response in the procurement will not be responsive or competitive because the County is not able to respond before the proposal receipt date or in sufficient time for the Proposer to prepare a responsive or competitive submittal.

O. PROGRAM ADMINISTRATION:

The County's Facilities Department and Road and Bridge Department have designated Program Administrators that will manage the work to be performed under the resultant contract, who for the purpose of this RFP are:

Lee Crowder
Road and Bridge Director
5115 TX-3
Dickinson, TX 77539

and

Will Riordan
Facilities Director
722 Moody, 6th Floor
Galveston, TX 77550

The Galveston County Commissioners Court, and/or authorized designees will be responsible for negotiating with the successful Vendor the scope of work, the standards of performance, the specific technology provided, and the support services required for the proposed projects. All contractual amendments will be processed in accordance with Galveston County Purchasing Policies. Amendments will also be brought to Galveston County Commissioners Court for approval as deemed necessary. The approval process serves to ensure the project technology and/or service is within the scope of the resultant contract, and that pricing meets the agreed upon pricing methodology as specified in the contract, and that funds are available.

P. SCOPE OF WORK

All proposers are to reference the **Technical Specifications Section** of this document for a detailed Scope of Work.

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Q. LABOR

Contractor is encouraged to use local labor, but not at the expense of poor workmanship and higher cost. Contractor will not discriminate against any employee or applicant for employment because of race, religion, color, sex or national origin. Contractor agrees to post in a conspicuous place a notice setting forth provisions of this non-discrimination clause.

R. SITE VISITS

It is imperative that prospective bidders visit the site to aid in providing a responsive proposal. ***Escorted access is required****. Prospective proposers can contact the Program Administrator for access to the facility for inspection.*

S. SAFETY

All prospective bidders will need to provide their OSHA 300 logs for the past three (3) years, display work crew safety training logs and safety policies and procedures for RFP committee purview. Safety is a primary concern of the county and the awardee will be required to follow all relevant OSHA Code of Federal Regulations regarding workplace safety. Violations of safety protocol will be addressed by the County Risk Manager and could lead to construction delays and possible termination of the contract.

T. CONSULTATION

Upon completion of site visit and inspection the bidder should provide information regarding the most advantageous methodology, solution, services, supplies, delivery and counsel in order to insure successful completion of this project. The ability of the bidder to inform and consult on the conditions of the equipment as well as work plan, starting, and finishing time will be heavily weighed and considered by the RFP evaluation committee.

U. INSURANCE

Respondent must submit, with its response, a current certificate of insurance evidencing coverage in the amounts specified below or greater. In lieu of submitting a certificate of insurance, Respondents may submit a notarized statement from an insurance company authorized to conduct business in the State of Texas guaranteeing that Respondent has such insurance. Provided however, that successful Respondent(s) shall be required to provide a current certificate of insurance to the Galveston County Purchasing Agent's Office before Respondent commences any work hereunder. **Insurance shall be placed with insurers having an A.M. Best's rating of no less than A**. Such insurance must be issued by a casualty company authorized to do business in the State of Texas, and in standard form approved by the Board of Insurance Commissioners of the State of Texas, with coverage provisions insuring the public from loss or damage that may arise to any person or property by reason of services rendered by Contractor.
Galveston County shall be listed as an additional insured on each policy and all certificates of insurance and Contractor shall provide Galveston County with no less than thirty (30) calendar days prior notice of any changes to the policy during the contractual period.

Certificates of Insurance, fully executed by a licensed representative of the insurance company written or countersigned by an authorized Texas state agency, shall be filed with the County Purchasing Agent within ten (10) calendar days of the execution of this Agreement as written proof of such insurance and further provided that Contractor shall not commence work under this Agreement until Contractor has obtained all insurance required herein, provided written proof as required herein, and received written notice to proceed issued from the County Purchasing Agent.

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Failure to provide such evidence of insurance within the ten (10) calendar day period shall constitute an event of default.

Workers' Compensation Insurance. Respondent shall carry in full force Workers' Compensation Insurance Policy(ies), if there is more than one employee, for all its employees, including but not limited to full time, part time, and emergency employees employed by the Contractor.

Commercial General Liability. Respondent shall carry in full force commercial general liability insurance with a limit of not less than $1,000,000 each occurrence and $2,000,000 in the aggregate. The Policy shall, minimally, cover liability for bodily injury, personal injury, and property damage.

Business Automobile Liability. Respondent shall carry in full force business automobile liability coverage with a combined bodily injury/property damage limit of not less than $1,000,000 each accident. The policy shall cover liability arising from the operation of licensed vehicles by policyholder.

Professional Liability. Respondent shall carry in full force professional liability insurance with limits of not less than $1,000,000.00.

V. EVALUATION CRITERIA AND AWARD

The award(s) will be made to the responsible proposer(s) whose proposal is determined to be the best evaluated offer demonstrating the best ability to fulfill the requirements set forth in this Request for Proposal. In awarding the contract, the Evaluation Committee may take into consideration the proposer's skill, capacity, experience, support capabilities, previous work/safety record, costs, the necessity of prompt and efficient completion of work described in the proposal documents, or other factors considered relevant.

The requested services will be awarded primarily based on the evaluation criteria listed below as well as complying with the provisions as stated on pages 6-7 of the General Provisions, Item 18, Award of Proposals – Evaluation Criteria and Factors.

METHODOLOGY – 35%

The following shall apply to this section:

- Ability of contractor to provide the most advantageous methodology, solution, services, and delivery as requested herein;
- The ability of the proposer to satisfy the detailed requirements outlined in this RFP;
- The ability of the proposer to satisfy the construction objectives outlined in this RFP;
- Completeness of work plan and ability to meet the goal of substantially completing the requested project within the requested or reasonably stated time frame.

COST – 35%

The Proposer shall provide pricing information relative to providing the proposed solution/system, services, and supplies as outlined herein. Included in the cost evaluation will be the total initial costs and on-going costs to the County;

REFERENCES, QUALIFICATIONS, AND EXPERIENCE – 15%

The proposer shall provide references and information describing the make-up and experience of the company personnel providing the construction services.

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SAFETY PLAN / SAFETY RECORD / EMR – 15%
The proposer shall include company adopted documentation outlining the procedures, rules, and regulations that are or will be put in place to protect workers over the course of the construction project. The proposer shall submit information with regard to their EMR (experience modification rate) as it applies to this request.

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SPECIAL PROVISIONS FOR CONSTRUCTION

1. Contract and Contract Documents

(a) The project to be constructed pursuant to this contract will be financed with assistance from FEMA and is subject to all applicable Federal and State laws and regulations.

(b) The Plans, Specifications and Addenda, General Provisions shall form part of this contract and the provisions thereof shall be as binding upon the parties hereto as if they were herein fully set forth.

2. Definitions

Whenever used in any of the contract Documents, the following meanings shall be given to the terms here in defined:

(a) The term "Contract" means the Contract executed between the County of Galveston, hereinafter called the Owner, and _____, hereinafter called Contractor, of which these GENERAL CONDITIONS, form a part.

(b) The term "Project Area" means the area within which are the specified Contract limits of the Improvements contemplated to be constructed in whole or in part under this contract.

(c) The term "Engineer" means Page Sutherland Page, Inc. Engineer in charge, serving the Owner with architectural or engineering services, his successor, or any other person or persons, employed by the Owner for the purpose of directing or having in charge the work embraced in this Contract.

(d) The term "Contract Documents" means and shall include the following: Invitation to Bid, , Signed Copy of Bid, General Conditions, Special Provisions For Construction, Acknowledgement and Certification Regarding Debarment, Non-Collusion Affidavit, Vendor Qualification Packet, Payment and Performance Bonds, Contract Award, Addenda (if any), Technical Specifications, and Drawings (as listed in the Schedule of Drawings).

(e) The term "Substantially Complete" shall mean that the work is fully completed with the exception of minor miscellaneous work and adjustments.

3. Supervision by Contractor

(a) Except where the Contractor is an individual and gives his personal supervision to the work, the Contractor shall provide a competent superintendent, satisfactory to the Local Public Agency and the Engineer, on the work at all times during working hours with full authority to act for him. The Contractor shall also provide an adequate staff for the proper coordination and expediting of his work.

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(b) The Contractor shall lay out his own work and he shall be responsible for all work executed by him under the Contract. He shall verify all figures and elevations before proceeding with the work and will be held responsible for any error resulting from his failure to do so.

4. Subcontracts

(a) The Contractor shall not execute an agreement with any subcontractor or permit any subcontractor to perform any work included in this contract until he has verified the subcontractor as eligible to participate in federally funded contracts.

(b) No proposed subcontractor shall be disapproved by the city/county except for cause.

(c) The Contractor shall be as fully responsible to the city/county for the acts and omissions of his subcontractors, and of persons either directly or indirectly employed by them.

(d) The Contractor shall cause appropriate provisions to be inserted in all subcontracts relative to the work and required compliance by each subcontractor with the applicable provisions of the Contract.

(e) Nothing contained in the Contract shall create any contractual relation between any subcontractor and the Owner.

5. Fitting and Coordination of Work

The Contractor shall be responsible for the proper fitting of all work and for the coordination of the operations of all trades, subcontractors, or material suppliers engaged upon this Contract.

6. Payments to Contractor

(a) Partial Payments

1) The Contractor shall prepare his requisition for partial payment as of the last day of the month and submit it, with the required number of copies, to the Engineer for his approval. The amount of the payment due the Contractor shall be determined by adding to the total value of work completed to date, the value of materials properly stored on the site and deducting (1) Five percent (5%) of the total amount, to be retained until final payment and (2) the amount of all previous payments. The total value of work completed to date shall be based on the estimated quantities of work completed and on the unit prices contained in the agreement. The value of materials properly stored on the site shall be based upon the estimated quantities of such materials and the invoice prices. Copies of all invoices shall be available for inspection of the Engineer.

2) Monthly or partial payments made by the Owner to the Contractor are moneys advanced for the purpose of assisting the contractor to expedite the work of construction. The Contractor shall be responsible for the care and protection of all materials and work upon which payments have been made until final acceptance of such work and materials by the Owner. Such payments shall not constitute a waiver of the right of the Owner to require the fulfillment of all terms of the Contract and the delivery of all improvements embraced in this Contract complete and satisfactory to the Owner in all details.

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(b) Final Payment

1) After final inspection and acceptance by the Owner of all work under the Contract, the Contractor shall prepare his requisition for final payment which shall be based upon the careful inspection of each item of work at the applicable unit prices stipulated in the Agreement. The total amount of the final payment due the Contractor under this contract shall be the amount computed as described above less all previous payments.

2) The Owner before paying the final estimate, shall require the Contractor to furnish releases or receipts from all subcontractors having performed any work and all persons having supplied materials, equipment (installed on the Project) and services to the Contractor, if the Owner deems it necessary in order to protect its interest. The Owner may, if it deems such action advisable, make payment in part or in full to the Contractor without requiring the furnishing of such releases or receipts and any payments made shall in no way impair the obligations of any surety or sureties furnished under this Contract.

3) Any amount due the Owner under Liquidated Damages shall be deducted from the final payment due the contractor.

(c) Payments Subject to Submission of Certificates

Each payment to the Contractor by the Owner shall be made subject to submission by the Contractor of all written certifications required of him and his subcontractors.

(d) Withholding Payments

The Owner may withhold from any payment due the Contractor whatever is deemed necessary to protect the Owner, and if so elects, may also withhold any amounts due from the Contractor to any subcontractors or material dealers, for work performed or material furnished by them. The foregoing provisions shall be construed solely for the benefit of the Owner and will not require the Owner to determine or adjust any claims or disputes between the Contractor and his subcontractors or material dealers, or to withhold any moneys for their protection unless the Owner elects to do so. The failure or refusal of the Owner to withhold any moneys from the Contractor shall in no way impair the obligations of any surety or sureties under any bond or bonds furnished under this Contract.

7. Changes in the Work

(a) The Owner may make changes in the scope of work required to be performed by the Contractor under the Contract without relieving or releasing the Contractor from any of his obligations under the Contract or any guarantee given by him pursuant to the Contract provisions, and without affecting the validity of the guaranty bonds, and without relieving or releasing the surety or sureties of said bonds. All such work shall be executed under the terms of the original Contract unless it is expressly provided otherwise.

(b) Except for the purpose of affording protection against any emergency endangering health, life, limb or property, the Contractor shall make no change in the materials used or in the specified manner of constructing and/or installing the improvements or supply additional labor, services or

materials beyond that actually required for the execution of the Contract, unless in pursuance of a written order from the Owner authorizing the Contractor to proceed with the change. No claim for an adjustment of the Contract Price will be valid unless so ordered.

(c) If applicable unit prices are contained in the Agreement, the Owner may order the Contractor to proceed with desired unit prices specified in the Contract; provided that in case of a unit price contract the net value of all changes does not increase the original total amount of the agreement by more than twenty-five percent (25%) or decrease the original the total amount by eighteen percent (18%).

(d) Each change order shall include in its final form:

1) A detailed description of the change in the work.

2) The Contractor's proposal (if any) or a confirmed copy thereof.

3) A definite statement as to the resulting change in the contract price and/or time.

4) The statement that all work involved in the change shall be performed in accordance with contract requirements except as modified by the change order.

5) The procedures as outlined in this Section for a unit price contract also apply in any lump sum contract.

8. Estimated Quantities

This Contract, including the specifications, plans and estimates, is intended to show clearly all the work to be done and material to be furnished hereunder. The estimated quantities of the various classes of work to be done and material to be furnished under this contract are approximate and are to be used as a basis for estimating the probable cost of the work and for comparing the proposals offered for the work. It is understood and agreed that the actual amount of work to be done and material to be furnished under this contract may differ somewhat from these estimates, and that the basis for payment under this contract shall be the plan quantity or actual amount of such work done whichever is specified. It is further understood that the County does not guarantee any minimum amount of work under this Contract.

Contractor agrees that it will make no claim for damages, anticipated profits or otherwise on account of any differences which may be found between the quantities of work actually done, the material actually furnished under this Contract and the estimated quantities contemplated and contained in the proposals.

9. Claims for Extra Cost

(a) If the Contractor claims that any instructions by Drawings or otherwise involve extra cost or extension of time, he shall, within ten days after the receipt of such instructions, and in any event before proceeding to execute the work, submit his protest thereto in writing to the Owner, stating clearly and in detail the basis of his objections. No such claim will be considered unless so made.

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(b) Claims for additional compensation for extra work, due to alleged errors in ground elevations, contour lines, or bench marks, will not be recognized unless accompanied by certified survey data, made prior to the time the original ground was disturbed, clearly showing that errors exist which resulted, or would result, in handling more material, or performing more work, than would be reasonably estimated from the Drawings and maps issued.

(c) Any discrepancies which may be discovered between actual conditions and those represented by the Drawings and maps shall be reported at once to the Owner and work shall not proceed except at the Contractor's risk, until written instructions have been received by him from the Owner.

(d) If, on the basis of the available evidence, the Owner determines that an adjustment of the Contract Price and/or time is justifiable, a change order shall be executed.

10. Time

The Contractor is advised that time for completion will consist of the number of calendar days set out in the Contract Award. The time for completion will begin to run on the day after the issuance of a notice to proceed by the County. The Contractor is required to start work no later than ten (10) working days after the issuance of the written notice to proceed. Failure to timely commence operations may be deemed by the County to be a default. The Contractor will complete the work at that site within the time period specified. If there is more than one site listed on the notice to proceed, work for all sites must be completed not later than is specified for each site.

11. Termination, Delays, and Liquidated Damages

(a) Right of the Owner to Terminate Contract.

In the event that any of the provisions of this contract are violated by the Contractor, or by any of his subcontractors, the Owner may serve written notice upon the Contractor and the Surety of its intention to terminate the contract.

The notices shall contain the reasons for such intention to terminate the contract, and unless such violation or delay shall cease and satisfactory arrangement of correction be made within ten days, the contract shall, upon the expiration of said ten (10) days, cease and terminate. In the event of any such termination, the Owner shall immediately serve notice thereof upon the Surety and the Contractor. The Surety shall have the right to take over and perform the contract. Provided, however, that if the Surety does not commence performance thereof within ten (10) days from the date of the mailing to such Surety of notice of termination, the Owner may take over the work and complete the project by bid/contract or by force account at the expense of the Contractor and his Surety shall be liable to the Owner for any excess cost incurred. In such event the Owner may take possession of and utilize in completing the work, such materials, appliances, and plant as may be on the site of the work and therefore necessary.

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(b) Liquidated Damages for Delays.

Contractor agrees that time is of the essence of this contract and that for each day of a delay of a day beyond the number of working days or calendar days herein agreed upon the completion of the work herein specified and contracted for (after due allowance for such extension of time as is provided for under Extension of Time hereinabove) County may withhold permanently from Contractor's total compensation the sum of $1,000.00 for each calendar day of delay, until the work is completed, as liquidated damages for such delay. The Contractor and his sureties shall be liable to the Owner for the amount thereof.

(c) Excusable Delays.

1) The right of the Contractor to proceed shall not be terminated nor shall the Contractor be charged with liquidated damages for any delays in the completion of the work due to:

a. Any acts of the Government, including controls or restrictions upon or requisitioning of materials, equipment, tools, or labor by reason of war, national defense, or any other national emergency;

b. Any acts of the Owner;

c. Causes not reasonably foreseeable by the parties to this Contract at the time of the execution of the Contract which are beyond the control and without the fault or negligence of the Contractor, including, but not restricted to, acts of God or of the public enemy, acts of another Contractor in the performance of some other contract with the Owner, fires, floods, epidemics, quarantine, restrictions, strikes, freight embargoes, and weather of unusual severity such as hurricanes, tornadoes, cyclones and other extreme weather conditions.

2) Provided, however, that the Contractor promptly notifies the Owner within ten (10) days in writing of the cause of the delay. Upon receipt of such notification, the Owner shall ascertain the facts and the cause and extent of delay. If, upon the basis of the facts and the terms of this contract, the delay is properly excusable, the Owner shall extend the time for completing the work for a period of time commensurate with the period of excusable delay.

12. Assignment or Novation

The Contractor shall not assign or transfer, whether by an assignment or novation, any of its rights, duties, benefits, obligations, liabilities, or responsibilities under this Contract without the written consent of the Owner; provided, however, that assignments to banks or other financial institutions may be made without the consent of the Owner. No assignment or novation of this Contract shall be valid unless the assignment or novation expressly provides that the assignment of any of the Contractor's rights or benefits under the Contract is subject to a prior lien for labor performed, services rendered, and materials, tools, and equipment supplied for the performance of the work under this Contract in favor of all persons, firms, or corporations rendering such labor or services or supplying such materials, tools, or equipment.

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13. Disputes

(a) All disputes arising under this Contract or its interpretation except those disputes covered by FEDERAL LABOR STANDARDS PROVISIONS whether involving law or fact or both, or extra work, and all claims for alleged breach of contract shall, within ten (10) days of commencement of the dispute, be presented by the Contractor to the Owner for decision. Any claim not presented within the time limit specified in this paragraph shall be deemed to have been waived, except that if the claim is of a continuing character and notice of the claim is not given within ten (10) days of its commencement, the claim will be considered only for a period commencing ten (10) days prior to the receipt of the Owner.

(b) The Contractor shall submit in detail his claim and his proof thereof.

(c) If the Contractor does not agree with any decision of the Owner, he shall in no case allow the dispute to delay the work but shall notify the Owner promptly that he is proceeding with the work under protest.

14. Technical Specifications and Drawings

Anything mentioned in the Technical Specifications and not shown on the Drawings, or vice versa, shall be of like effect as if shown on or mentioned in both. In case of difference between Drawings and Technical Specifications, the Technical Specifications shall govern. In case of any discrepancy in Drawings, or Technical Specifications, the matter shall be immediately submitted to the Owner, without whose decision, said discrepancy shall not be adjusted by the Contractor, save only at his own risk and expense.

15. Shop Drawings

(a) All required shop drawings, machinery details, layout drawings, etc. shall be submitted to the Engineer in copies for approval sufficiently in advance of requirements to afford ample time for checking, including time for correcting, resubmitting and rechecking if necessary. The Contractor may proceed, only at his own risk, with manufacture or installation of any equipment or work covered by said shop drawings, etc. until they are approved and no claim, by the Contractor, for extension of the contract time shall be granted by reason of his failure in this respect.

(b) Any drawings submitted without the Contractor's stamp of approval will not be considered and will be returned to him for proper resubmission. If any drawings show variations from the requirements of the Contract because of standard shop practice or other reason, the Contractor shall make specific mention of such variation in his letter of transmittal in order that, if acceptable, suitable action may be taken for proper adjustment of contract price and/or time, otherwise the Contractor will not be relieved of the responsibility for executing the work in accordance with the Contract even though the drawings have been approved.

(c) If a shop drawing is in accordance with the contract or involves only a minor adjustment in the interest of the owner not involving a change in contract price or time; the engineer may approve the drawing. The approval shall not relieve the Contractor from his responsibility for adherence to the contract or for any error in the drawing.

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16. Requests for Supplementary Information

It shall be the responsibility of the Contractor to make timely requests of the Owner for any additional information not already in his possession which should be furnished by the Owner under the terms of this Contract, and which he will require in the planning and execution of the work. Such requests may be submitted from time to time as the need approaches, but each shall be filed in ample time to permit appropriate action to be taken by all parties involved so as to avoid delay. Each request shall be in writing and list the various items and the latest date by which each will be required by the Contractor. The first list shall be submitted within two weeks after Contract award and shall be as complete as possible at that time. The Contractor shall, if requested, furnish promptly any assistance and information the Engineer may require in responding to these requests of the Contractor. The Contractor shall be fully responsible for any delay in his work or to others arising from his failure to comply fully with the provision of this section.

17. Materials and Workmanship

(a) Unless otherwise specifically provided for in the technical specifications, all workmanship, equipment, materials and articles incorporated in the work shall be new and the best grade of the respective kinds for the purpose. Where equipment, materials, articles or workmanship are referred to in the technical specifications as "equal to" any particular standard, the Engineer shall decide the question of equality.

(b) The Contractor shall furnish to the Owner for approval the manufacturer's detailed specifications for all machinery, mechanical and other special equipment, which he contemplates installing together with full information as to type, performance characteristics, and all other pertinent information as required, and shall likewise submit for approval full information concerning all other materials or articles which he proposes to incorporate.

(c) Machinery, mechanical and other equipment, materials or articles installed or used without such prior approval shall be at the risk of subsequent rejection.

(d) Materials specified by reference to the number or symbol of a specific standard, shall comply with requirements in the latest revision thereof and any amendment or supplement thereto in effect on the date of the Invitation for Bids, except as limited to type, class or grade, or modified in the technical specifications shall have full force and effect as though printed therein.

(e) The Owner may require the Contractor to dismiss from the work such employee or employees as the Owner or the Engineer may deem incompetent, or careless, or insubordinate.

18. Samples, Certificates and Tests

(a) The Contractor shall submit all material or equipment samples, certificates, affidavits, etc., as called for in the contract documents or required by the Engineer, promptly after award of the contract and acceptance of the Contractor's bond. No such material or equipment shall be manufactured or delivered to the site, except at the Contractor's own risk, until the required samples or certificates have been approved in writing by the Engineer. Any delay in the work caused by late or improper submission of samples or certificates for approval shall not be considered just cause for an extension of the contract time.

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(b) Each sample submitted by the Contractor shall carry a label giving the name of the Contractor, the project for which it is intended, and the name of the producer. The accompanying certificate or letter from the Contractor shall state that the sample complies with contract requirements, shall give the name and brand of the product, its place of origin, the name and address of the producer and all specifications or other detailed information which will assist the Engineer in making a prompt decision regarding the acceptability of the sample. It shall also include the statement that all materials or equipment furnished for use in the project will comply with the samples and/or certified statements.

(c) Approval of any materials shall be general only and shall not constitute a waiver of the Owner's right to demand full compliance with Contract requirements. After actual deliveries, the Engineer will have such check tests made as he deems necessary in each instance and may reject materials and equipment and accessories for cause, even though such materials and articles have been given general approval. If materials, equipment or accessories which fail to meet check tests have been incorporated in the work, the Engineer will have the right to cause their removal and replacement by proper materials or to demand and secure such reparation by the Contractor as is equitable.

(d) Except as otherwise specifically stated in the Contract, the costs of sampling and testing will be divided as follows:

1) The Contractor shall furnish without extra cost, including packing and delivery charges, all samples required for testing purposes, except those samples taken on the project by the Engineer;

2) The Contractor shall assume all costs of re-testing materials which fail to meet contract requirements;

3) The Contractor shall assume all costs of testing materials offered in substitution for those found deficient;

4) The Owner will pay all other expenses.

19. Permits and Codes

(a) The Contractor shall give all notices required by and comply with all applicable laws, ordinances, and codes of the Local Government. All construction work and/or utility installations shall comply with all applicable ordinances, and codes including all written waivers. Before installing any work, the Contractor shall examine the drawings and technical specifications for compliance with applicable ordinances and codes and shall immediately report any discrepancy to the Owner. Where the requirements of the drawings and technical specifications fail to comply with such applicable ordinances or codes, the Owner will adjust the Contract by Change Order to conform to such ordinances or codes (unless waivers in writing covering the difference have been granted by the governing body or department) and make appropriate adjustment in the Contract Price or stipulated unit prices.

(b) Should the Contractor fail to observe the foregoing provisions and proceed with the construction and/or install any utility at variance with any applicable ordinance or code, including any written

waivers (notwithstanding the fact that such installation is in compliance with the drawings and technical specifications), the Contractor shall remove such work without cost to the Owner.

(c) The Contractor shall at his own expense, secure and pay for all permits for street pavement, sidewalks, shed, removal of abandoned water taps, sealing of house connection drains, pavement cuts, buildings, electrical, plumbing, water, gas and sewer permits required by the local regulatory body or any of its agencies.

(d) The Contractor shall comply with applicable local laws and ordinances governing the disposal of surplus excavation, materials, debris and rubbish on or off the Project Area and commit no trespass on any public or private property in any operation due to or connected with the Improvements contained in this Contract.

(e) The Contractor will be required to make arrangements for and pay the water. electrical power, or any other utilities required during construction.

(f) During construction of this project, the Contractor shall use every means possible to control the amount of dust created by construction. Prior to the close of a day's work, the Contractor, if directed by the Owner, shall moisten the bank and surrounding area to prevent a dusty condition.

20. Care of Work

(a) The Contractor shall be responsible for all damages to person or property that occur as a result of his fault or negligence in connection with the prosecution of the work and shall be responsible for the proper care and protection of all materials delivered and work performed until completion and final acceptance.

(b) The Contractor shall provide sufficient competent watchmen, both day and night, including Saturdays, Sundays, and holidays, from the time the work is commenced until final completion and acceptance.

(c) In an emergency affecting the safety of life, limb or property, including adjoining property, the Contractor, without special instructions or authorization from the Owner is authorized to act at his discretion to prevent such threatened loss or injury, and he shall so act. He shall likewise act if instructed to do so by the Owner.

(d) The Contractor shall avoid damage as a result of his operations to existing sidewalks, streets, curbs, pavements, utilities (except those which are to be replaced or removed), adjoining property, etc., and he shall at his own expense completely repair any damage thereto caused by his operations.

(e) The Contractor shall shore up, brace, underpin, secure, and protect as maybe necessary, all foundations and other parts of existing structures adjacent to, adjoining, and in the vicinity of the site, which may be in any way affected by the excavations or other operations connected with the construction of the improvements included in this Contract. The Contractor shall be responsible for the giving of any and all required notices to any adjoining or adjacent property owner or other party before the commencement of any work. The Contractor shall indemnify and save harmless the Owner from any damages on account of settlements or the loss of lateral support of adjoining

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property and from all loss or expense and all damages for which the Owner may become liable in consequence of such injury or damage to adjoining and adjacent structures and their premises.

21. Accident Prevention

(a) No laborer or mechanic employed in the performance of this Contract shall be required to work in surroundings or under working conditions which are unsanitary, hazardous, or dangerous to his health or safety as determined under construction safety and health standards promulgated by the Secretary of Labor.

(b) The Contractor shall exercise proper precaution at all times for the protection of persons and property and shall be responsible for all damages to persons or property, either on or off the site, which occur as a result of his prosecution of the work.

(c) The Contractor shall maintain an accurate record of all cases of death, occupational disease, or injury requiring medical attention or causing loss of time from work, arising out of and in the course of employment on work under the Contract. The Contractor shall promptly furnish the Owner with reports concerning these matters.

(d) The Contractor shall indemnify and save harmless the Owner from any claims for damages resulting from property damage, personal injury and/or death suffered or alleged to have been suffered by any person as a result of any work conducted under this contract.

(e) The Contractor shall provide trench safety for all excavations more than five feet deep prior to excavation. All OSHA Standards for trench safety must be adhered to by the Contractor.

(f) The contractor shall at all times conduct his work in such a manner as to insure the least possible inconvenience to vehicular and pedestrian traffic. At the close of the work each day, all streets where possible in the opinion of the Owner, shall be opened to the public in order that persons living in the area may have access to their homes or businesses by the use of the streets. Barricades, warning signs, and necessary lighting shall be provided to the satisfaction of the Owner at the expense of the Contractor.

22. Sanitary Facilities

The Contractor shall furnish, install and maintain ample sanitary facilities for the workmen. As the needs arise, a sufficient number of enclosed temporary toilets shall be conveniently placed as required. Drinking water shall be provided from an approved source, so piped or transported as to keep it safe and fresh and served from single service containers or satisfactory types of sanitary drinking stands or fountains. All such facilities and services shall be furnished in strict accordance with existing and governing health regulations.

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23. Use of Premises

(a) The Contractor shall confine his equipment, storage of materials, and construction operations to the contract limits as shown on the drawings and as prescribed by ordinances or permits, or as may be desired by the Owner, and shall not unreasonably encumber the site or public rights of way with his materials and construction equipment.

(b) The Contractor shall comply with all reasonable instructions of the Owner and all existing state and local regulations regarding signs, advertising, traffic, fires, explosives, danger signals, and barricades.

24. Removal of Debris, Cleaning, Etc.

The Contractor shall, periodically or as directed during the progress of the work, remove and legally dispose of all surplus excavated material and debris, and keep the Project Area and public rights of way reasonably clear.

Upon completion of the work, contractor shall remove all temporary construction facilities, debris and unused materials provided for work, and put the whole site of the work and public rights of way in a neat and clean condition.

25. Inspection

(a) All materials and workmanship shall be subject to inspection, examination, or test by the Owner and Engineer at any and all times during manufacture or construction and at any and all places where such manufacture or construction occurs. The Owner shall have the right to reject defective material and workmanship or require its correction. Unacceptable workmanship shall be satisfactorily corrected.
Rejected material shall be promptly segregated and removed from the Project Area and replaced with material of specified quality without charge. If the Contractor fails to proceed at once with the correction of rejected workmanship or defective material, the Owner may by contract or otherwise have the defects remedied or rejected materials removed from the Project Area and charge the cost of the same against any Monies which may be due the Contractor, without prejudice to any other rights or remedies of the Owner.

(b) The Contractor shall furnish promptly all materials reasonably necessary for any tests which may be required. All tests by the Owner will be performed in such manner as not to delay the work unnecessarily and will be made in accordance with the provisions of the technical specifications.

(c) The Contractor shall notify the Owner sufficiently in advance of back filling or concealing any facilities to permit proper inspection. If any facilities are concealed without approval or consent of the Owner, the Contractor shall uncover for inspection and recover such facilities at his own expense, when so requested by the Owner.

(d) Should it be considered necessary or advisable by the Owner at any time before final acceptance of the entire work to make an examination of work already completed by uncovering the same, the Contractor shall on request promptly furnish all necessary facilities, labor, and material. If such

work is found to be defective in any important or essential respect, due to fault of the Contractor or his subcontractors, the Contractor shall defray all the expenses of such examination and of satisfactory reconstruction. If, however, such work is found to meet the requirements of the Contract, the actual cost of labor and material necessarily involved in the examination and replacement, shall be allowed the Contractor and he shall, in addition, if completion of the work of the entire Contract has been delayed thereby, be granted a suitable extension of time on account of the additional work involved.

(e) Inspection of materials and appurtenances to be incorporated in the improvements included in this Contract may be made at the place of production, manufacture or shipment, whenever the quantity justifies it, and such inspection and acceptance, unless otherwise stated in the technical specifications, shall be final, except as regards (1) latent defects, (2) departures from specific requirements of the Contract, (3) damage or loss in transit, or (4) fraud or such gross mistakes as amount to fraud. Subject to the requirements contained in the preceding sentence, the inspection of materials as a whole or in part will be made at the Project Site.

(f) Neither inspection, testing, approval nor acceptance of the work in whole or in part, by the Owner or its agents shall relieve the Contractor or his sureties of full responsibility for materials furnished or work performed not in strict accordance with the Contract.

26. Review by Owner

The Owner and its authorized representatives and agents shall have access to and be permitted to observe and review all work, materials, equipment, payrolls, personnel records, employment conditions, material invoices, and other relevant data and records pertaining to this Contract, provided, however that all instructions and approval with respect to the work will be given to the Contractor only by the Owner through its authorized representatives or agents.

27. Final Inspection

When the Improvements included in this Contract are substantially completed, the Contractor shall notify the Owner in writing that the work will be ready for final inspection on a definite date which shall be stated in the notice. The Owner will make the arrangements necessary to have final inspection commenced on the date stated in the notice, or as soon thereafter as is practicable.

28. Deduction for Uncorrected Work

If the Owner deems it not expedient to require the Contractor to correct work not done in accordance with the Contract Documents, an equitable deduction from the Contract Price will be made by agreement between the Contractor and the Owner and subject to settlement, in case of dispute, as herein provided.

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29. Warranty of Title

No material, supplies, or equipment to be installed or furnished under this Contract shall be purchased subject to any chattel mortgage or under a conditional sale, lease-purchase or other agreement by which an interest is retained by the seller or supplier. The Contractor shall warrant good title to all materials, supplies, and equipment installed or incorporated in the work and upon completion of all work, shall deliver the same together with all improvements and appurtenances constructed or placed by him to the Owner free from any claims, liens, or charges. Neither the Contractor nor any person, firm, or corporation furnishing any material or labor for any work covered by this Contract shall have any right to a lien upon any improvement or appurtenance. Nothing contained in this paragraph, however, shall defeat or impair the right of persons furnishing materials or labor to recover under any law permitting such persons to look to funds due the Contractor in the hands of the Owner. The provisions of this paragraph shall be inserted in all subcontracts and material contracts and notice of its provisions shall be given to all persons furnishing materials for the work when no formal contract is entered into for such materials.

30. Warranty of Workmanship and Materials

Neither the final certificate of payment nor any provision in the Contract nor partial or entire use of the improvements included in this Contract by the Owner or the public shall constitute an acceptance of work not done in accordance with the Contract or relieve the Contractor of liability in respect to any express warranties or responsibility for faulty materials or workmanship. The Contractor shall promptly remedy any defects in the work and pay for any damage to other work resulting therefrom which shall appear within a period of 12 months from the date of final acceptance of the work.

31. Job Offices

(a) The Contractor and his subcontractors may maintain such office and storage facilities on the site as are necessary for the proper conduct of the work. These shall be located so as to cause no interference to any work to be performed on the site. The Owner shall be consulted with regard to locations.

(b) Upon completion of the improvements, or as directed by the Owner, the Contractors shall remove all such temporary structures and facilities from the site and leave the site of the work in the condition required by the contract.

32. Partial Use of Site Improvements

The Owner may give notice to the Contractor and place in use those sections of the improvements which have been completed, inspected and can be accepted as complying with the technical specifications and if in its opinion, each such section is reasonably safe, fit, and convenient for the use and accommodation for which it was intended, provided:

(a) The use of such sections of the Improvements shall in no way impede the completion of the remainder of the work by the Contractor.

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(b) The Contractor shall not be responsible for any damages or maintenance costs due directly to the use of such sections.

(c) The period of guarantee stipulated in the Section 29 hereof shall not begin to run until the date of the final acceptance of all work which the Contractor is required to construct under this Contract.

33. Contract Period

The work to be performed under this contract shall commence within the time stipulated by the Owner in the Notice to Proceed and shall be fully completed within 365 calendar days thereafter.

34. Keeping of Plans and Specifications Accessible

The Contractor shall keep one (1) copy of all Plans and Specifications constantly accessible at the work site and available for inspection at all times.

35. Utilities

Contractor shall be responsible for any charges which may be made by any city or utility companies for the work to be performed by Contractor.

36. Parking

Contractor shall be responsible for the expense of parking the Contractor's vehicle(s) in a legal manner and at no expense or inconvenience to the County.

37. Fire and Safety

Contractor is completely responsible for fire protection at the job site as well as the safety of its own employees as well as those entering onto the job site.

38. Contractor's Buildings

The building of structures for housing men, or the erection of tents or other forms of protection will be permitted only at such places as the County shall permit, and the sanitary conditions of the grounds in or about such structures shall at all times be maintained in the manner satisfactory to the County.

39. Worksite Security

Contractor shall maintain the security of the worksite.

Contractor shall provide adequate protection to persons on the worksite, adjacent properties, and utilities as is necessary to keep each free of damage or injury. Contractor shall furnish all barricades, warning lights

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and other safety devices necessary for the safety and protection of the public and shall remove them upon completion of the work performed on those premises under the terms of this contract.

Contractor will have complete control over the work site and shall be fully responsible for any loss of or damage to any County property from any cause and will reimburse County in the event of any loss or damage to County's property from any cause.
Contractor shall take proper means to protect adjacent or adjoining properties which might be injured or seriously affected by construction undertaken under this Agreement from any damage or injury by reason of said process of construction. Contractor shall be liable for any and all claims for such damage on account of its failure to fully protect all adjoining properties.

40. Final Grading

If grading is required, when work is complete, Contractor shall grade the site to fill in holes and make a presentable appearance without disturbing trees and add fill dirt if needed. Contractor may not leave voids in the grading and compaction of the property. The land shall have a smooth appearance without concrete, bricks, building materials, and other debris on the surface.

41. Changes and Alterations

Contractor further agrees that County may make such changes and alterations as County may see fit, in the line, grade, form dimensions, plans or materials for the work herein contemplated, or any part thereof, either before or after the beginning of the contract construction, without affecting the validity of this Contract and the accompanying bonds.

If such changes or alterations diminish the quantity of the work to be done, they shall not constitute the basis for a claim for damages, or anticipated profits on the work that may be dispensed with. If they increase the amount of the work, and the increased work can fairly be classified under the specifications, such increase shall be paid for according to the quantity actually done and at the unit price established for such work under this contract; otherwise such additional work shall be paid for as provided under the paragraph entitled "EXTRA WORK". In case the County shall make such changes or alterations as shall make useless any work already done or material already furnished or used in said work, then County shall recompense Contractor for any material or labor so used, and for any actual loss occasioned by such change due to actual expenses incurred in preparation for the work as originally planned.

42. Extra Work

The term "Extra Work" as used in this contract shall be understood to mean and include all work that may be required by the County to be done by Contractor to accomplish any change, alteration or addition to the work shown in the plans and specifications.

It is agreed that Contractor shall perform all Extra Work under the direction of the County when presented with a Written Work Order signed by the County. It is also agreed that the compensation to be paid Contractor for performing said Extra Work shall be determined by one or more of the following methods:

Method (a) - By agreed unit prices; or

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Method (b) - By agreed lump sum: or

Method (c) - If Neither Method (a) nor Method (b) can be agreed upon before the Extra Work is commenced, then Contractor shall be paid the "Actual field cost" of the work plus fifteen (15) percent.

In the event said Extra Work be performed and paid for under Method (c), then the provisions of this paragraph shall apply and the "actual field cost" is hereby defined to include the cost of all workmen, such as foremen, timekeepers, merchants, and laborers, and materials, supplies, teams, trucks, rentals on machinery and equipment for time actually employed or used on such Extra Work plus actual transportation charges necessarily incurred, if the kind of equipment or machinery is not already on the job, together with all power, fuel, lubricants, water and similar operating expenses, also all necessary incidental expenses incurred directly on account of such Extra Work including Social Security, Old Age Benefits and other payroll taxes, and a ratable proportion of premiums on Construction and Maintenance Bonds, Public Liability and Property Damage and Workmen's Compensation, and all other insurance as may be required by any law or ordinance. The County may direct the form in which accounts of the "actual field cost" shall be kept and may also specify in writing, before the work commences, the method of doing the work and the type and kind of machinery and equipment to be used, otherwise these matters shall be determined by Contractor. Unless otherwise agreed upon, the prices for the use of machinery and equipment shall be determined by using the one hundred (100) percent of the actual hourly or daily rate (for the time used plus time in moving to and from Job) of the latest schedule of Equipment Ownership Expense adopted by the Association General Contractors of America. Where practicable the terms and prices for the use of Machinery and Equipment shall be incorporated in the Written Extra Work Order. The fifteen (15) percent of the "Actual Field Cost" to be paid Contractor shall cover and compensate him for his profit, overhead, general superintendence and field office expense, and all other elements of cost and expense not embraced within the 'actual field cost" as herein defined, save that where the Contractor's Camp or Field Office must be maintained primarily on account of such extra work, then the cost to maintain and operate same shall be included in the "actual field cost".

No claim for extra work of any kind will be allowed unless ordered in writing by the County. In case any orders or instructions, either oral or written appear to Contractor to involve extra work for which he should receive compensation, it shall make written request to the County for written order authorizing Extra Work. Should a difference of opinion arise as to what does or does not constitute extra work, or as to the payment therefor, and the County insists upon its performance, Contractor shall proceed with the work after making written order and shall keep an accurate account of the "actual field cost" thereof, as provided under Method (c) and by this action Contractor will thereby preserve the right to submit the matter of payment to litigation.

43. Salvage

Any materials, equipment and fixtures specifically ordered to be salvaged under these specifications shall remain the property of County and will be delivered to the site designated by the County. All other items shall be disposed of by Contractor in compliance with all applicable laws and regulations.

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44. Compliance with Codes

Contractor shall comply with all city, county, and state codes, laws, and ordinances in force at the time of award of contract and applicable to such work. Contractor shall obtain, at Contractor's own expense such permits, certificates, and licenses as may be required in the performance of the specified work.

45. Laws and Ordinances

Contractor shall at all times observe and comply with all Federal, State and Local Laws, ordinances and regulations which in any manner effect the contract or the work, and shall indemnify and save harmless the County against any claim arising from the violation of any such laws and ordinances, whether by Contractor or its employees.

46. Permits and Licenses

Contractor shall be responsible for obtaining and furnishing all necessary permits and licenses, City, County, State or Federal as are required for the performance of this contract.

47. Lines and Grades

The Engineer will furnish points for horizontal and vertical control. Any additional stakes required by the Contractor shall be set at his expense. Whenever necessary, work shall be suspended to permit this work, but such suspension will be as brief as practicable and the Contractor shall be allowed no extra compensation therefor. The Contractor shall give the Engineer ample notice of the time and place where control lines and benchmarks will be needed. All control stakes, marks, etc. shall be carefully preserved by the Contractor, and in case of careless destruction or removal by him or his employees, such control stakes, marks, etc. shall be replaced by the Engineer at the Contractor's expense.

48. Excess, Waste Material and Debris

All excess material, waste material and debris shall become the property of the Contractor and shall be properly disposed of off-site. No separate payment shall be made for same.

49. Material Hauling

Hauling of materials will not be paid for directly, however, shall be considered as subsidiary work pertaining to the respective bid items. Haul routes for full and empty loads shall be restricted to State Highways. Hauling of equipment is also restricted to State Highways.

50. Abatement and Mitigation of Excessive or Unnecessary Construction Noise

Throughout all phases of the construction of this project, including the moving, unloading, operating and handling of construction equipment prior to commencement of work, during the project and after the work

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is complete, the contractor shall make every reasonable effort to minimize the noise imposed upon the immediate neighborhood surrounding the area of construction. Particular and special efforts shall be exercised by the Contractor to avoid the creation of unnecessary noise impacts on adjacent sensitive receptors in the placement of non-mobile equipment such as air compressors, generators, pumps, etc. The placement of temporary parked mobile equipment with the engine running shall be such as to cause the least disruption of normal adjacent activities not associated with the work to be performed by the contractor.

All equipment associated with the work shall be equipped with components designed by the manufacturer wholly or in part to suppress excessive noise and these components shall be maintained in their original operating condition considering normal depreciation. Noise-attenuation devices installed by the manufacturer such as mufflers, engine covers, insulation, etc., shall not be removed nor rendered ineffectual nor be permitted to remain off the equipment while the equipment is in use.

51. Working Hours

Work shall not be commenced by the contractor before sunrise and shall be so conducted that all equipment is off the road and safely stored by sunset. Specific permission shall be obtained by the contractor from the Engineer for work during those hours between 7:00 P.M. and 6:00 A.M. of the following day.

52. Pipeline, Utility Locations and Contractor Responsibility

An effort to determine all pipelines and utilities which may impact the project has been made. All known pipelines and utilities have been approximately located and shown on the plans. The Contractor shall notify all utility and pipeline owners before beginning the work. Additional unknown utilities and pipelines may be found. Adjustments of these utilities or pipelines shall be done by others at no expense to the contractor. However, the Contractor shall cooperate and coordinate his work with the adjustment

The Contractor will anticipate this in making his bid. The contractor will not be allowed claims for damages or delays for these adjustments should they be necessary. However, additional time will be considered for the contract period.

This action, however, shall in no way be interpreted as relieving the Contractor of his responsibilities under the terms of the contract as set out in the plans and specifications. The Contractor shall repair any damage to the facilities caused by his operations at the Contractor's expense and shall restore facilities to service in a timely manner.

53. Incidentals

All items of work required under this contract not specifically called for in the proposal as pay items shall be considered incidental to the various bid items and no separate payment shall be made for same.

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54. Flagmen

During certain phases of construction flagmen will be required to direct and control traffic. This work will not be paid for directly, however, shall be considered incidental the various bid items and no separate payment shall be made for same.

55. Field Office

For this project the Contractor will provide a job trailer.

56. Wage Rates:

The attached schedule of wages per hour for this Contract follows.

"General Decision Number: TX20200248 08/28/2020

Superseded General Decision Number: TX20190248

State: Texas

Construction Type: Building

County: Galveston County in Texas.

BUILDING CONSTRUCTION PROJECTS (does not include single family homes or apartments up to and including 4 stories).

Note: Under Executive Order (EO) 13658, an hourly minimum wage of $10.80 for calendar year 2020 applies to all contracts subject to the Davis-Bacon Act for which the contract is awarded (and any solicitation was issued) on or after January 1, 2015. If this contract is covered by the EO, the contractor must pay all workers in any classification listed on this wage determination at least $10.80 per hour (or the applicable wage rate listed on this wage determination, if it is higher) for all hours spent performing on the contract in calendar year 2020. If this contract is covered by the EO and a classification considered necessary for performance of work on the contract does not appear on this wage determination, the contractor must pay workers in that classification at least the wage rate determined through the conformance process set forth in 29 CFR 5.5(a)(1)(ii) (or the EO minimum wage rate,if it is higher than the conformed wage rate). The EO minimum wage rate will be adjusted annually. Please note that this EO applies to the above-mentioned types of contracts entered into by the federal government that are subject to the Davis-Bacon Act itself, but it does not apply to contracts subject only to the Davis-Bacon Related Acts, including those set forth at 29 CFR 5.1(a)(2)-(60). Additional information on contractor requirements and worker protections under the EO is available at www.dol.gov/whd/govcontracts.

Modification Number	Publication Date
0	01/03/2020
1	02/14/2020
2	08/28/2020

ASBE0022-009 06/01/2019

	Rates	Fringes
ASBESTOS WORKER/HEAT & FROST INSULATOR (Duct, Pipe and		

Mechanical System Insulation)....$ 24.28 14.16

BOIL0074-003 01/01/2017

	Rates	Fringes
BOILERMAKER.....	$ 28.00	22.35

CARP0551-011 04/01/2016

	Rates	Fringes
CARPENTER (Excludes Acoustical Ceiling Installation, Drywall Finishing/Taping, Drywall Hanging, Form Work and Metal Stud Installation).....	$ 23.05	8.78

ELEC0527-002 10/28/2019

	Rates	Fringes
ELECTRICIAN (Excludes Low Voltage Wiring and Installation of Alarms).....	$ 29.43	3% + 10.65

ELEV0031-003 01/01/2020

	Rates	Fringes
ELEVATOR MECHANIC.....	$ 44.00	34.765

FOOTNOTES:

A. 6% under 5 years based on regular hourly rate for all hours worked. 8% over 5 years based on regular hourly rate for all hours worked.

B. Holidays: New Year's Day; Memorial Day; Independence Day; Labor Day; Thanksgiving Day; Friday after Thanksgiving Day; Christmas Day; and Veterans Day.

ENGI0450-002 04/01/2014

	Rates	Fringes
POWER EQUIPMENT OPERATOR		
Cranes.....	$ 34.85	9.85

IRON0084-011 06/01/2019

	Rates	Fringes
IRONWORKER, ORNAMENTAL	$ 24.42	7.12

PAIN0130-002 06/01/2018

	Rates	Fringes
PAINTER (Brush, Roller, and Drywall Finishing/Taping)	$ 17.88	9.50

PLAS0079-004 01/01/2015

	Rates	Fringes
PLASTERER	$ 19.92	1.00

PLUM0068-002 10/01/2019

	Rates	Fringes
PLUMBER	$ 36.15	11.04

PLUM0211-010 10/01/2018

	Rates	Fringes
PIPEFITTER (Including HVAC Pipe Installation)	$ 33.30	12.26

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* SHEE0054-012 04/01/2020

	Rates	Fringes
SHEET METAL WORKER		
Excludes HVAC Duct and Unit Installation	$ 29.70	13.85
HVAC Duct Installation Only	$ 29.70	13.85

SUTX2014-024 07/21/2014

	Rates	Fringes
ACOUSTICAL CEILING MECHANIC	$ 16.41	3.98
BRICKLAYER	$ 19.86	0.00
CAULKER	$ 15.36	0.00

CEMENT MASON/CONCRETE FINISHER	$ 13.82	0.00
DRYWALL HANGER AND METAL STUD INSTALLER	$ 17.88	5.24
ELECTRICIAN (Alarm Installation Only)	$ 17.97	3.37
ELECTRICIAN (Low Voltage Wiring Only)	$ 19.23	3.55
FLOOR LAYER: Carpet	$ 20.00	0.00
FORM WORKER	$ 12.07	0.00
GLAZIER	$ 17.09	3.41
HVAC MECHANIC (Installation of HVAC Unit Only)	$ 17.40	0.00
IRONWORKER, REINFORCING	$ 12.10	0.00
IRONWORKER, STRUCTURAL	$ 25.37	6.00
LABORER: Common or General	$ 11.47	0.00
LABORER: Mason Tender - Brick	$ 13.37	0.00
LABORER: Mason Tender - Cement/Concrete	$ 10.50	0.00
LABORER: Pipelayer	$ 12.94	0.00
LABORER: Roof Tearoff	$ 11.28	0.00
LABORER: Landscape and Irrigation	$ 9.49	0.00
LATHER	$ 20.11	0.00
OPERATOR: Backhoe/Excavator/Trackhoe	$ 14.10	0.00
OPERATOR: Bobcat/Skid Steer/Skid Loader	$ 13.93	0.00
OPERATOR: Bulldozer	$ 20.77	0.00
OPERATOR: Drill	$ 16.22	0.34

OPERATOR: Forklift.....$ 15.64 0.00

OPERATOR: Grader/Blade.....$ 13.37 0.00

OPERATOR: Loader.....$ 13.55 0.94

OPERATOR: Mechanic.....$ 17.52 3.33

OPERATOR: Paver (Asphalt,
Aggregate, and Concrete).....$ 16.03 0.00

OPERATOR: Roller.....$ 16.00 0.00

PAINTER: Spray (Excludes
Drywall Finishing/Taping).....$ 17.43 4.43

ROOFER.....$ 15.40 0.00

SPRINKLER FITTER (Fire
Sprinklers).....$ 18.62 3.03

TILE FINISHER.....$ 12.00 0.00

TILE SETTER.....$ 16.17 0.00

TRUCK DRIVER: 1/Single Axle
Truck.....$ 14.95 5.23

TRUCK DRIVER: Dump Truck.....$ 12.39 1.18

TRUCK DRIVER: Flatbed Truck.....$ 19.65 8.57

TRUCK DRIVER: Semi-Trailer
Truck.....$ 12.50 0.00

TRUCK DRIVER: Water Truck.....$ 12.00 4.11

WATERPROOFER.....$ 14.39 0.00

WELDERS - Receive rate prescribed for craft performing
operation to which welding is incidental.

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Note: Executive Order (EO) 13706, Establishing Paid Sick Leave
for Federal Contractors applies to all contracts subject to the
Davis-Bacon Act for which the contract is awarded (and any
solicitation was issued) on or after January 1, 2017. If this

contract is covered by the EO, the contractor must provide employees with 1 hour of paid sick leave for every 30 hours they work, up to 56 hours of paid sick leave each year. Employees must be permitted to use paid sick leave for their own illness, injury or other health-related needs, including preventive care; to assist a family member (or person who is like family to the employee) who is ill, injured, or has other health-related needs, including preventive care; or for reasons resulting from, or to assist a family member (or person who is like family to the employee) who is a victim of, domestic violence, sexual assault, or stalking. Additional information on contractor requirements and worker protections under the EO is available at www.dol.gov/whd/govcontracts.

Unlisted classifications needed for work not included within the scope of the classifications listed may be added after award only as provided in the labor standards contract clauses (29CFR 5.5 (a) (1) (ii)).

The body of each wage determination lists the classification and wage rates that have been found to be prevailing for the cited type(s) of construction in the area covered by the wage determination. The classifications are listed in alphabetical order of ""identifiers"" that indicate whether the particular rate is a union rate (current union negotiated rate for local), a survey rate (weighted average rate) or a union average rate (weighted union average rate).

Union Rate Identifiers

A four letter classification abbreviation identifier enclosed in dotted lines beginning with characters other than ""SU"" or ""UAVG"" denotes that the union classification and rate were prevailing for that classification in the survey. Example: PLUM0198-005 07/01/2014. PLUM is an abbreviation identifier of the union which prevailed in the survey for this classification, which in this example would be Plumbers. 0198 indicates the local union number or district council number where applicable, i.e., Plumbers Local 0198. The next number, 005 in the example, is an internal number used in processing the wage determination. 07/01/2014 is the effective date of the most current negotiated rate, which in this example is July 1, 2014.

Union prevailing wage rates are updated to reflect all rate changes in the collective bargaining agreement (CBA) governing

this classification and rate.

Survey Rate Identifiers

Classifications listed under the ""SU"" identifier indicate that no one rate prevailed for this classification in the survey and the published rate is derived by computing a weighted average rate based on all the rates reported in the survey for that classification. As this weighted average rate includes all rates reported in the survey, it may include both union and non-union rates. Example: SULA2012-007 5/13/2014. SU indicates the rates are survey rates based on a weighted average calculation of rates and are not majority rates. LA indicates the State of Louisiana. 2012 is the year of survey on which these classifications and rates are based. The next number, 007 in the example, is an internal number used in producing the wage determination. 5/13/2014 indicates the survey completion date for the classifications and rates under that identifier.

Survey wage rates are not updated and remain in effect until a new survey is conducted.

Union Average Rate Identifiers

Classification(s) listed under the UAVG identifier indicate that no single majority rate prevailed for those classifications; however, 100% of the data reported for the classifications was union data. EXAMPLE: UAVG-OH-0010 08/29/2014. UAVG indicates that the rate is a weighted union average rate. OH indicates the state. The next number, 0010 in the example, is an internal number used in producing the wage determination. 08/29/2014 indicates the survey completion date for the classifications and rates under that identifier.

A UAVG rate will be updated once a year, usually in January of each year, to reflect a weighted average of the current negotiated/CBA rate of the union locals from which the rate is based.

WAGE DETERMINATION APPEALS PROCESS

1.) Has there been an initial decision in the matter? This can be:

* an existing published wage determination
* a survey underlying a wage determination

* a Wage and Hour Division letter setting forth a position on a wage determination matter
* a conformance (additional classification and rate) ruling

On survey related matters, initial contact, including requests for summaries of surveys, should be with the Wage and Hour Regional Office for the area in which the survey was conducted because those Regional Offices have responsibility for the Davis-Bacon survey program. If the response from this initial contact is not satisfactory, then the process described in 2.) and 3.) should be followed.

With regard to any other matter not yet ripe for the formal process described here, initial contact should be with the Branch of Construction Wage Determinations. Write to:

Branch of Construction Wage Determinations
Wage and Hour Division
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

2.) If the answer to the question in 1.) is yes, then an interested party (those affected by the action) can request review and reconsideration from the Wage and Hour Administrator (See 29 CFR Part 1.8 and 29 CFR Part 7). Write to:

Wage and Hour Administrator
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

The request should be accompanied by a full statement of the interested party's position and by any information (wage payment data, project description, area practice material, etc.) that the requestor considers relevant to the issue.

3.) If the decision of the Administrator is not favorable, an interested party may appeal directly to the Administrative Review Board (formerly the Wage Appeals Board). Write to:

Administrative Review Board
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

4.) All decisions by the Administrative Review Board are final.

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END OF GENERAL DECISION"

CONSENT OF SURETY TO REDUCTION IN OR PARTIAL RELEASE OF RETAINAGE

TO:

PROJECT NO.

PROJECT:
Galveston County Road & Bridge Facility Rebuild Project

CONTRACT FOR:

CONTRACT DATE:

In accordance with the provisions of the Contract between the Owner and the Contractor as indicated above, the

, SURETY,

On bond of (here insert name and address of Contractor as it appears in the bond)

, CONTRACTOR,

Hereby approves the reduction in or partial release of retainage to the contractor as follows:

The Surety agrees that such reduction in or partial release of retainage to the Contractor shall not relieve the Surety of any of its obligations to (here insert name and address of Owner)

, OWNER,

As set forth in the said Surety's bond

IN WITNESS WHEREOF,
The Surety has hereunto set its had this day of 20,

_____
SURETY

_____
Signature of Authorized Representative

_____
Title

ATTEST:
(Seal):

CONTRACTOR'S AFFIDAVIT OF RELEASE OF LIEN:

TO(Owner):

PROJECT NO:

CONTRACT FOR:

PROJECT:
Galveston County Road & Bridge Facility Rebuild Project

CONTRACT DATE:

State of:

County of:

The undersigned, hereby certifies that, to the best of his knowledge, information and belief, except as listed below, the Releases or Waivers of Lien attached hereto include the Contractor, all Subcontractors, all suppliers of materials and equipment, and all performers of Work, labor or services who have or may have liens against any property of the Owner arising in any manner out of the performance of the Contract referenced above.

EXCEPTIONS: (If none, write "None". If required by the Owner, the Contractor shall furnish bond satisfactory to the Owner for each exception)

SUPPORTING DOCUMENTS ATTACHED HERETO:

1. Contractor's Release or Waiver of Liens, Conditional upon receipt of final payment.

2. Separate Releases or Waivers of Liens from Sub-contractors and material and equipment Suppliers, to the extent required by the Owner, accompanied by a list thereof.

Contractor:

Address:

BY:

Subscribed and sworn to before me this day of _____, 2020

Notary Public:

My Commission Expires:

CONTRACTOR'S AFFIDAVIT OF PAYMENT OF DEBTS AND CLAIMS

TO (Owner):

PROJECT NO:

CONTRACT FOR:

PROJECT:
Galveston County Road & Bridge Facility Rebuild Project

CONTRACT DATE:

State of:

County of:

The undersigned, hereby certifies that, except as listed below, he has paid in full or has otherwise satisfied all obligations for all materials and equipment furnished, for all work, labor, and services performed, and for all known indebtedness and claims against the Contractor for damages arising in any manner in connection with the performance of the Contract referenced above for which the Owner or his property might in any way be held responsible.

EXCEPTIONS: (If none, write "None". If required by the Owner, the Contractor shall furnish bond satisfactory to the Owner for each exception.)

SUPPORTING DOCUMENTS ATTACHED HERETO:

1. Consent of Surety to Final Payment. Whenever Surety is involved, consent of Surety is required. CONSENT OF SURETY, may be used for this purpose. Indicate attachment; yes_____ no____

The following supporting documents should be Attached hereto if required by the Owner:

1. Contractor's Release or Waiver of Liens, Conditional upon receipt of final payment.
2. Separate Releases or Waivers of Liens from Sub-contractors and material and equipment Suppliers to the extent required by the Owner, Accompanied by a list thereof.
3. Contractor's Affidavit of Release of Lien.

CONTRACTOR:

Address:

BY:

Subscribed and sworn to before me this

day of 20

Notary Public:

My Commission Expires:

CONSENT OF SURETY COMPANY TO FINAL PAYMENT

TO (Owner):

PROJECT NO:

CONTRACT FOR:

PROJECT:
Galveston County Road & Bridge Facility Rebuild Project

CONTRACT DATE:

In accordance with the provisions of the Contract between the Owner and the Contractor as indicated above, the (here insert name and address of Surety at it appears in the bond)

, SURETY COMPANY.

On bond of (here insert name and address of Contractor)

, CONTRACTOR,

Hereby approves of the final payment to the Contractor, and agrees that final payment to the Contractor shall not relieve the Surety Company of any of its obligations to (here insert name and address of Owner)

, OWNER,

As set forth in the said Surety Company's bond.

IN WITNESS WHEREOF, day of , 2020.

_____
Surety Company

_____
Signature of Authorized Representative

_____
Title

ATTEST:
(Seal)

NOTE: This form is to be used as a companion document to Contractor's Affidavit of Payment of Debts and Claims.

REQUEST FOR PROPOSALS
GALVESTON COUNTY ROAD & BRIDGE FACILITY REBUILD PROJECT
SPECIAL PROVISIONS

CONTRACT AWARD

CONTRACT FOR: GALVESTON COUNTY ROAD & BRIDGE FACILITY REBUILD PROJECT

THIS CONTRACT IS ENTERED INTO BETWEEN GALVESTON COUNTY AND THE CONTRACTOR NAMED BELOW PURSUANT TO SUBCHAPTER B, CHAPTER 271, TEXAS LOCAL GOVERNMENT CODE, AND THE REFERENCED INVITATION TO BID.

Contract No: CM20306

Bid No: RFP #B201044

Contractor: _____

The Specifications and Drawings are enumerated as follows:

Standard Specifications: Page Sutherland Page's Specifications

Special Provisions: None

Special Items: None

DRAWINGS:
ADDENDA: _____

REQUEST FOR PROPOSALS
GALVESTON COUNTY ROAD & BRIDGE FACILITY REBUILD PROJECT
SPECIAL PROVISIONS

Contract Award (continued)

The Request for Proposal, General Provisions, Special Provisions, Proposal Forms, Non-Collusion Affidavit, Vendor Qualification Packet, Debarment Form, Special Provisions for Construction, Bid Proposal, Affidavit and Surety Forms, Wage Rates, Specifications and Plans attached to this Contract Award are all made a part of this Contract and collectively evidence and constitute the entire contract. Contractor shall furnish all materials, perform all of the work required to be done and do everything else required by these documents.

Time of Completion: The Contractor shall complete the work within _____ Calendar Days of the issuance of the Notice to Proceed. The time set forth for completion of the work is an essential element of the Contract.

The Contract Sum: The County shall pay the Contractor for performance of the Contract, the sum of _____
_____Dollars and ___/100 ($_____), payments to be made as described herein.

Performance Bond required: (x) yes ( ) no
Payment Bond required: (x) yes ( ) no

This Contract is issued pursuant to award made by Commissioners' Court on _____, 20___.

EXECUTED this _____ day of _____, 20___.

COUNTY OF GALVESTON, TEXAS

BY: _____
MARK HENRY, County Judge

ATTEST:

_____
DWIGHT SULLIVAN, County Clerk

CONTRACTOR: _____

BY: _____
Signature – Title

_____
Printed Name

EXHIBIT A
GALVESTON COUNTY ROAD & BRIDGE FACILITY REBUILD PROJECT
GALVESTON COUNTY, TEXAS

PROCUREMENT STANDARDS

2 C.F.R. §§ 200.317 – 200.326 & 2 C.F.R. PART 200, APPENDIX II

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PROCUREMENT STANDARDS

2 C.F.R. §§ 200.317 – 200.326 & 2 C.F.R. PART 200, APPENDIX II

2 C.F.R. § **200.317. Procurements by states.**

When procuring property and services under a Federal award, a state must follow the same policies and procedures it uses for procurements from its non-Federal funds. The state will comply with §200.322 Procurement of recovered materials and ensure that every purchase order or other contract includes any clauses required by section §200.326 Contract provisions. All other non-Federal entities, including subrecipients of a state, will follow §§ 200.318 General procurement standards through 200.326 Contract provisions.

69 FR 26280, May 11, 2004; 78 FR 78608, Dec. 26, 20313

2 C.F.R. § **200.318. General procurement standards.**

(a) The non-Federal entity must use its own documented procurement procedures which reflect applicable State, local and tribal laws and regulations, provided that the procurements conform to applicable Federal law and the standards identified in this part.

(b) Non-Federal entities must maintain oversight to ensure that contractors perform in accordance with the terms, conditions, and specifications of their contracts or purchase orders.

(c)

(1) The non-Federal entity must maintain written standards of conduct covering conflicts of interest and governing the actions of its employees engaged in the selection, award and administration of contracts. No employee, officer, or agent may participate in the selection, award, or administration of a contract supported by a Federal award if he or she has a real or apparent conflict of interest. Such a conflict of interest would arise when the employee, officer, or agent, any member of his or her immediate family, his or her partner, or an organization which employs or is about to employ any of the parties indicated herein, has a financial or other interest in or a tangible personal benefit from a firm considered for a contract. The officers, employees, and agents of the non-Federal entity may neither solicit nor accept gratuities, favors, or anything of monetary value from contractors or parties to subcontracts. However, non-Federal entities may set standards for situations in which the financial interest is not substantial or the gift is an unsolicited item of nominal value. The standards of conduct must provide for disciplinary actions to be applied for violations of such standards by officers, employees, or agents of the non-Federal entity.

(2) If the non-Federal entity has a parent, affiliate, or subsidiary organization that is not a state, local government, or Indian tribe, the non-Federal entity must also maintain written standards of conduct covering organizational conflicts of interest. Organizational conflicts of interest means that because of

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relationships with a parent company, affiliate, or subsidiary organization, the non-Federal entity is unable or appears to be unable to be impartial in conducting a procurement action involving a related organization.

(d) The non-Federal entity's procedures must avoid acquisition of unnecessary or duplicative items. Consideration should be given to consolidating or breaking out procurements to obtain a more economical purchase. Where appropriate, an analysis will be made of lease versus purchase alternatives, and any other appropriate analysis to determine the most economical approach.

(e) To foster greater economy and efficiency, and in accordance with efforts to promote cost-effective use of shared services across the Federal Government, the non-Federal entity is encouraged to enter into state and local intergovernmental agreements or inter-entity agreements where appropriate for procurement or use of common or shared goods and services.

(f) The non-Federal entity is encouraged to use Federal excess and surplus property in lieu of purchasing new equipment and property whenever such use is feasible and reduces project costs.

(g) The non-Federal entity is encouraged to use value engineering clauses in contracts for construction projects of sufficient size to offer reasonable opportunities for cost reductions. Value engineering is a systematic and creative analysis of each contract item or task to ensure that its essential function is provided at the overall lower cost.

(h) The non-Federal entity must award contracts only to responsible contractors possessing the ability to perform successfully under the terms and conditions of a proposed procurement. Consideration will be given to such matters as contractor integrity, compliance with public policy, record of past performance, and financial and technical resources. See also § 200.213 Suspension and debarment.

(i) The non-Federal entity must maintain records sufficient to detail the history of procurement. These records will include, but are not necessarily limited to the following: rationale for the method of procurement, selection of contract type, contractor selection or rejection, and the basis for the contract price.

(j)

(1) The non-Federal entity may use a time and materials type contract only after a determination that no other contract is suitable and if the contract includes a ceiling price that the contractor exceeds at its own risk. Time and materials type contract means a contract whose cost to a non-Federal entity is the sum of:

(i) The actual cost of materials; and

(ii) Direct labor hours charged at fixed hourly rates that reflect wages, general and administrative expenses, and profit.

(2) Since this formula generates an open-ended contract price, a time-and-materials contract provides no positive profit incentive to the contractor for cost control or labor efficiency. Therefore, each contract must set a ceiling price that the contractor exceeds at its own risk. Further, the non-Federal entity awarding such a contract must assert a high degree of oversight in order to obtain reasonable assurance that the contractor is using efficient methods and effective cost controls.

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(k) The non-Federal entity alone must be responsible, in accordance with good administrative practice and sound business judgment, for the settlement of all contractual and administrative issues arising out of procurements. These issues include, but are not limited to, source evaluation, protests, disputes, and claims. These standards do not relieve the non-Federal entity of any contractual responsibilities under its contracts. The Federal awarding agency will not substitute its judgment for that of the non-Federal entity unless the matter is primarily a Federal concern. Violations of law will be referred to the local, state, or Federal authority having proper jurisdiction.

78 FR 78608, Dec. 26, 2013, as amended at 79 FR 75885, Dec. 19, 2014; 80 FR 43309, July 22, 2015; 80 FR 45395, July 30, 2015

2 C.F.R. **§ 200.319. Competition.**

(a) All procurement transactions must be conducted in a manner providing full and open competition consistent with the standards of this section. In order to ensure objective contractor performance and eliminate unfair competitive advantage, contractors that develop or draft specifications, requirements, statements of work, or invitations for bids or requests for proposals must be excluded from competing for such procurements. Some of the situations considered to be restrictive of competition include but are not limited to:

(1) Placing unreasonable requirements on firms in order for them to qualify to do business;

(2) Requiring unnecessary experience and excessive bonding;

(3) Noncompetitive pricing practices between firms or between affiliated companies;

(4) Noncompetitive contracts to consultants that are on retainer contracts;

(5) Organizational conflicts of interest;

(6) Specifying only a "brand name" product instead of allowing "an equal" product to be offered and describing the performance or other relevant requirements of the procurement; and

(7) Any arbitrary action in the procurement process.

(b) The non-Federal entity must conduct procurements in a manner that prohibits the use of statutorily or administratively imposed state, local, or tribal geographical preferences in the evaluation of bids or proposals, except in those cases where applicable Federal statutes expressly mandate or encourage geographic preference. Nothing in this section preempts state licensing laws. When contracting for architectural and engineering (A/E) services, geographic location may be a selection criterion provided its application leaves an appropriate number of qualified firms, given the nature and size of the project, to compete for the contract.

(c) The non-Federal entity must have written procedures for procurement transactions. These procedures must ensure that all solicitations:

(1) Incorporate a clear and accurate description of the technical requirements for the material, product, or service to be procured. Such description must not, in competitive procurements, contain features which unduly

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restrict competition. The description may include a statement of the qualitative nature of the material, product or service to be procured and, when necessary, must set forth those minimum essential characteristics and standards to which it must conform if it is to satisfy its intended use. Detailed product specifications should be avoided if at all possible. When it is impractical or uneconomical to make a clear and accurate description of the technical requirements, a "brand name or equivalent" description may be used as a means to define the performance or other salient requirements of procurement. The specific features of the named brand which must be met by offers must be clearly stated; and

(2) Identify all requirements which the offerors must fulfill and all other factors to be used in evaluating bids or proposals.

(d) The non-Federal entity must ensure that all prequalified lists of persons, firms, or products which are used in acquiring goods and services are current and include enough qualified sources to ensure maximum open and free competition. Also, the non-Federal entity must not preclude potential bidders from qualifying during the solicitation period.

78 FR 78608, Dec. 26, 2013, as amended at 79 FR 75885, Dec. 19, 2014

2 C.F.R. **§ 200.320. Methods of procurement to be followed.**

The non-Federal entity must use one of the following methods of procurement.

(a) Procurement by micro-purchases. Procurement by micro-purchase is the acquisition of supplies or services, the aggregate dollar amount of which does not exceed the micro-purchase threshold (§200.67 Micro-purchase). To the extent practicable, the non-Federal entity must distribute micro-purchases equitably among qualified suppliers. Micro-purchases may be awarded without soliciting competitive quotations if the non-Federal entity considers the price to be reasonable.

(b) Procurement by small purchase procedures. Small purchase procedures are those relatively simple and informal procurement methods for securing services, supplies, or other property that do not cost more than the Simplified Acquisition Threshold. If small purchase procedures are used, price or rate quotations must be obtained from an adequate number of qualified sources.

(c) Procurement by sealed bids (formal advertising). Bids are publicly solicited and a firm fixed price contract (lump sum or unit price) is awarded to the responsible bidder whose bid, conforming with all the material terms and conditions of the invitation for bids, is the lowest in price. The sealed bid method is the preferred method for procuring construction, if the conditions in paragraph (c)(1) of this section apply.

(1) In order for sealed bidding to be feasible, the following conditions should be present:

(i) A complete, adequate, and realistic specification or purchase description is available;

(ii) Two or more responsible bidders are willing and able to compete effectively for the business; and

(iii) The procurement lends itself to a firm fixed price contract and the selection of the successful bidder can be made principally on the basis of price.

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(2) If sealed bids are used, the following requirements apply:

(i) Bids must be solicited from an adequate number of known suppliers, providing them sufficient response time prior to the date set for opening the bids, for local, and tribal governments, the invitation for bids must be publicly advertised;

(ii) The invitation for bids, which will include any specifications and pertinent attachments, must define the items or services in order for the bidder to properly respond;

(iii) All bids will be opened at the time and place prescribed in the invitation for bids, and for local and tribal governments, the bids must be opened publicly;

(iv) A firm fixed price contract award will be made in writing to the lowest responsive and responsible bidder. Where specified in bidding documents, factors such as discounts, transportation cost, and life cycle costs must be considered in determining which bid is lowest. Payment discounts will only be used to determine the low bid when prior experience indicates that such discounts are usually taken advantage of; and

(v) Any or all bids may be rejected if there is a sound documented reason.

(d) Procurement by competitive proposals. The technique of competitive proposals is normally conducted with more than one source submitting an offer, and either a fixed price or cost-reimbursement type contract is awarded. It is generally used when conditions are not appropriate for the use of sealed bids. If this method is used, the following requirements apply:

(1) Requests for proposals must be publicized and identify all evaluation factors and their relative importance. Any response to publicized requests for proposals must be considered to the maximum extent practical;

(2) Proposals must be solicited from an adequate number of qualified sources;

(3) The non-Federal entity must have a written method for conducting technical evaluations of the proposals received and for selecting recipients;

(4) Contracts must be awarded to the responsible firm whose proposal is most advantageous to the program, with price and other factors considered; and

(5) The non-Federal entity may use competitive proposal procedures for qualifications-based procurement of architectural/engineering (A/E) professional services whereby competitors' qualifications are evaluated and the most qualified competitor is selected, subject to negotiation of fair and reasonable compensation. The method, where price is not used as a selection factor, can only be used in procurement of A/E professional services. It cannot be used to purchase other types of services though A/E firms are a potential source to perform the proposed effort.

(e) [Reserved]

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(f) Procurement by noncompetitive proposals. Procurement by noncompetitive proposals is procurement through solicitation of a proposal from only one source and may be used only when one or more of the following circumstances apply:

(1) The item is available only from a single source;

(2) The public exigency or emergency for the requirement will not permit a delay resulting from competitive solicitation;

(3) The Federal awarding agency or pass-through entity expressly authorizes noncompetitive proposals in response to a written request from the non-Federal entity; or

(4) After solicitation of a number of sources, competition is determined inadequate.

78 FR 78608, Dec. 26, 2013, as amended at 79 FR 75885, Dec. 19, 2014; 80 FR 54409, Sept. 10, 2015

2 C.F.R. **§ 200.321. Contracting with small and minority businesses, women's business enterprises, and labor surplus area firms.**

(a) The non-Federal entity must take all necessary affirmative steps to assure that minority businesses, women's business enterprises, and labor surplus area firms are used when possible.

(b) Affirmative steps must include:

(1) Placing qualified small and minority businesses and women's business enterprises on solicitation lists;

(2) Assuring that small and minority businesses, and women's business enterprises are solicited whenever they are potential sources;

(3) Dividing total requirements, when economically feasible, into smaller tasks or quantities to permit maximum participation by small and minority businesses, and women's business enterprises;

(4) Establishing delivery schedules, where the requirement permits, which encourage participation by small and minority businesses, and women's business enterprises;

(5) Using the services and assistance, as appropriate, of such organizations as the Small Business Administration and the Minority Business Development Agency of the Department of Commerce; and

(6) Requiring the prime contractor, if subcontracts are to be let, to take the affirmative steps listed in paragraphs (1) through (5) of this section.

69 FR 26280, May 11, 2004; 78 FR 78608, Dec. 26, 2013, unless otherwise noted

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2 C.F.R. **§ 200.322. Procurement of recovered materials.**

A non-Federal entity that is a state agency or agency of a political subdivision of a state and its contractors must comply with section 6002 of the Solid Waste Disposal Act, as amended by the Resource Conservation and Recovery Act. The requirements of Section 6002 include procuring only items designated in guidelines of the Environmental Protection Agency (EPA) at 40 CFR part 247 that contain the highest percentage of recovered materials practicable, consistent with maintaining a satisfactory level of competition, where the purchase price of the item exceeds $10,000 or the value of the quantity acquired during the preceding fiscal year exceeded $10,000; procuring solid waste management services in a manner that maximizes energy and resource recovery; and establishing an affirmative procurement program for procurement of recovered materials identified in the EPA guidelines.

78 FR 78608, Dec. 26, 2013, as amended at 79 FR 75885, Dec. 19, 2014

2 C.F.R. **§ 200.323. Contract cost and price.**

(a) The non-Federal entity must perform a cost or price analysis in connection with every procurement action in excess of the Simplified Acquisition Threshold including contract modifications. The method and degree of analysis is dependent on the facts surrounding the particular procurement situation, but as a starting point, the non-Federal entity must make independent estimates before receiving bids or proposals.

(b) The non-Federal entity must negotiate profit as a separate element of the price for each contract in which there is no price competition and in all cases where cost analysis is performed. To establish a fair and reasonable profit, consideration must be given to the complexity of the work to be performed, the risk borne by the contractor, the contractor's investment, the amount of subcontracting, the quality of its record of past performance, and industry profit rates in the surrounding geographical area for similar work.

(c) Costs or prices based on estimated costs for contracts under the Federal award are allowable only to the extent that costs incurred or cost estimates included in negotiated prices would be allowable for the non-Federal entity under Subpart E—Cost Principles of this part. The non-Federal entity may reference its own cost principles that comply with the Federal cost principles.

(d) The cost plus a percentage of cost and percentage of construction cost methods of contracting must not be used.

69 FR 26280, May 11, 2004; 78 FR 78608, Dec. 26, 2013, unless otherwise noted

2 C.F.R. **§ 200.324. Federal awarding agency or pass-through entity review.**

(a) The non-Federal entity must make available, upon request of the Federal awarding agency or pass-through entity, technical specifications on proposed procurements where the Federal awarding agency or pass-through entity believes such review is needed to ensure that the item or service specified is the one being proposed for acquisition. This review generally will take place prior to the time the specification is incorporated into a solicitation document. However, if the non-Federal entity desires to have the review accomplished after a solicitation has been developed, the Federal awarding agency or pass-through entity may still review the specifications, with such review usually limited to the technical aspects of the proposed purchase.

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(b) The non-Federal entity must make available upon request, for the Federal awarding agency or pass-through entity pre-procurement review, procurement documents, such as requests for proposals or invitations for bids, or independent cost estimates, when:

(1) The non-Federal entity's procurement procedures or operation fails to comply with the procurement standards in this part;

(2) The procurement is expected to exceed the Simplified Acquisition Threshold and is to be awarded without competition or only one bid or offer is received in response to a solicitation;

(3) The procurement, which is expected to exceed the Simplified Acquisition Threshold, specifies a "brand name" product;

(4) The proposed contract is more than the Simplified Acquisition Threshold and is to be awarded to other than the apparent low bidder under a sealed bid procurement; or

(5) A proposed contract modification changes the scope of a contract or increases the contract amount by more than the Simplified Acquisition Threshold.

(c) The non-Federal entity is exempt from the pre-procurement review in paragraph (b) of this section if the Federal awarding agency or pass-through entity determines that its procurement systems comply with the standards of this part.

(1) The non-Federal entity may request that its procurement system be reviewed by the Federal awarding agency or pass-through entity to determine whether its system meets these standards in order for its system to be certified. Generally, these reviews must occur where there is continuous high-dollar funding, and third party contracts are awarded on a regular basis;

(2) The non-Federal entity may self-certify its procurement system. Such self-certification must not limit the Federal awarding agency's right to survey the system. Under a self-certification procedure, the Federal awarding agency may rely on written assurances from the non-Federal entity that it is complying with these standards. The non-Federal entity must cite specific policies, procedures, regulations, or standards as being in compliance with these requirements and have its system available for review.

69 FR 26280, May 11, 2004; 78 FR 78608, Dec. 26, 2013, unless otherwise noted

2 C.F.R. § 200.325. Bonding requirements.

For construction or facility improvement contracts or subcontracts exceeding the Simplified Acquisition Threshold, the Federal awarding agency or pass-through entity may accept the bonding policy and requirements of the non-Federal entity provided that the Federal awarding agency or pass-through entity has made a determination that the Federal interest is adequately protected. If such a determination has not been made, the minimum requirements must be as follows:

(a) A bid guarantee from each bidder equivalent to five percent of the bid price. The "bid guarantee" must consist of a firm commitment such as a bid bond, certified check, or other negotiable instrument accompanying a bid as assurance that the bidder will, upon acceptance of the bid, execute such contractual documents as may be required within the time specified.

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(b) A performance bond on the part of the contractor for 100 percent of the contract price. A "performance bond" is one executed in connection with a contract to secure fulfillment of all the contractor's obligations under such contract.

(c) A payment bond on the part of the contractor for 100 percent of the contract price. A "payment bond" is one executed in connection with a contract to assure payment as required by law of all persons supplying labor and material in the execution of the work provided for in the contract.

69 FR 26280, May 11, 2004; 78FR 78608, Dec. 26, 2013, unless otherwise noted

2 C.F.R. **§ 200.326. Contract provisions.**

The non-Federal entity's contracts must contain the applicable provisions described in Appendix II to Part 200—Contract Provisions for non-Federal Entity Contracts Under Federal Awards.

69 FR 26280, May 11, 2004; 78 FR 78608, Dec. 26, 2013, unless otherwise note

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2 C.F.R. Part, 200, Appendix II

In addition to other provisions required by the Federal agency or non-Federal entity, all contracts made by the non-Federal entity under the Federal award must contain provisions covering the following, as applicable.

(A) Contracts for more than the simplified acquisition threshold currently set at $150,000, which is the inflation adjusted amount determined by the Civilian Agency Acquisition Council and the Defense Acquisition Regulations Council (Councils) as authorized by 41 U.S.C. 1908, must address administrative, contractual, or legal remedies in instances where contractors violate or breach contract terms, and provide for such sanctions and penalties as appropriate.

(B) All contracts in excess of $10,000 must address termination for cause and for convenience by the non-Federal entity including the manner by which it will be effected and the basis for settlement.

(C) Equal Employment Opportunity. Except as otherwise provided under 41 CFR Part 60, all contracts that meet the definition of "federally assisted construction contract" in 41 CFR Part 60-1.3 must include the equal opportunity clause provided under 41 CFR 60-1.4(b), in accordance with Executive Order 11246, "Equal Employment Opportunity" (30 FR 12319, 12935, 3 CFR Part, 1964-1965 Comp., p. 339), as amended by Executive Order 11375, "Amending Executive Order 11246 Relating to Equal Employment Opportunity," and implementing regulations at 41 CFR part 60, "Office of Federal Contract Compliance Programs, Equal Employment Opportunity, Department of Labor."

(D) Davis-Bacon Act, as amended (40 U.S.C. 3141-3148). When required by Federal program legislation, all prime construction contracts in excess of $2,000 awarded by non-Federal entities must include a provision for compliance with the Davis-Bacon Act (40 U.S.C. 3141-3144, and 3146-3148) as supplemented by Department of Labor regulations (29 CFR Part 5, "Labor Standards Provisions Applicable to Contracts Covering Federally Financed and Assisted Construction"). In accordance with the statute, contractors must be required to pay wages to laborers and mechanics at a rate not less than the prevailing wages specified in a wage determination made by the Secretary of Labor. In addition, contractors must be required to pay wages not less than once a week. The non-Federal entity must place a copy of the current prevailing wage determination issued by the Department of Labor in each solicitation. The decision to award a contract or subcontract must be conditioned upon the acceptance of the wage determination. The non-Federal entity must report all suspected or reported violations to the Federal awarding agency. The contracts must also include a provision for compliance with the Copeland "Anti-Kickback" Act (40 U.S.C. 3145), as supplemented by Department of Labor regulations (29 CFR Part 3, "Contractors and Subcontractors on Public Building or Public Work Financed in Whole or in Part by Loans or Grants from the United States"). The Act provides that each contractor or subrecipient must be prohibited from inducing, by any means, any person employed in the construction, completion, or repair of public work, to give up any part of the compensation to which he or she is otherwise entitled. The non-Federal entity must report all suspected or reported violations to the Federal awarding agency.

(E) Contract Work Hours and Safety Standards Act (40 U.S.C. 3701-3708). Where applicable, all contracts awarded by the non-Federal entity in excess of $100,000 that involve the employment of mechanics or laborers must include a provision for compliance with 40 U.S.C. 3702 and 3704, as supplemented by Department of Labor regulations (29 CFR Part 5). Under 40 U.S.C. 3702 of the Act, each contractor must be required to compute the wages of every mechanic and laborer on the basis of a standard work week of 40 hours. Work in excess of the standard work week is permissible provided that the worker is compensated at a rate of not less than one and a half times the basic rate of pay for all hours worked in excess of 40 hours in the work week. The requirements of 40 U.S.C. 3704 are applicable to construction work and provide that no laborer or mechanic must be required to work in surroundings or under working conditions which are unsanitary, hazardous or

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dangerous. These requirements do not apply to the purchases of supplies or materials or articles ordinarily available on the open market, or contracts for transportation or transmission of intelligence.

(F) Rights to Inventions Made Under a Contract or Agreement. If the Federal award meets the definition of "funding agreement" under 37 CFR §401.2 (a) and the recipient or subrecipient wishes to enter into a contract with a small business firm or nonprofit organization regarding the substitution of parties, assignment or performance of experimental, developmental, or research work under that "funding agreement," the recipient or subrecipient must comply with the requirements of 37 CFR Part 401, "Rights to Inventions Made by Nonprofit Organizations and Small Business Firms Under Government Grants, Contracts and Cooperative Agreements," and any implementing regulations issued by the awarding agency.

(G) Clean Air Act (42 U.S.C. 7401-7671q.) and the Federal Water Pollution Control Act (33 U.S.C. 1251-1387), as amended—Contracts and subgrants of amounts in excess of $150,000 must contain a provision that requires the non-Federal award to agree to comply with all applicable standards, orders or regulations issued pursuant to the Clean Air Act (42 U.S.C. 7401-7671q) and the Federal Water Pollution Control Act as amended (33 U.S.C. 1251-1387). Violations must be reported to the Federal awarding agency and the Regional Office of the Environmental Protection Agency (EPA).

(H) Debarment and Suspension (Executive Orders 12549 and 12689)—A contract award (see 2 CFR 180.220) must not be made to parties listed on the governmentwide exclusions in the System for Award Management (SAM), in accordance with the OMB guidelines at 2 CFR 180 that implement Executive Orders 12549 (3 CFR part 1986 Comp., p. 189) and 12689 (3 CFR part 1989 Comp., p. 235), "Debarment and Suspension." SAM Exclusions contains the names of parties debarred, suspended, or otherwise excluded by agencies, as well as parties declared ineligible under statutory or regulatory authority other than Executive Order 12549.

(I) Byrd Anti-Lobbying Amendment (31 U.S.C. 1352)—Contractors that apply or bid for an award exceeding $100,000 must file the required certification. Each tier certifies to the tier above that it will not and has not used Federal appropriated funds to pay any person or organization for influencing or attempting to influence an officer or employee of any agency, a member of Congress, officer or employee of Congress, or an employee of a member of Congress in connection with obtaining any Federal contract, grant or any other award covered by 31 U.S.C. 1352. Each tier must also disclose any lobbying with non-Federal funds that takes place in connection with obtaining any Federal award. Such disclosures are forwarded from tier to tier up to the non-Federal award.

(J) See §200.322 Procurement of recovered materials.

78 FR 78608, Dec. 26, 2013, as amended at 79 FR 75888, Dec. 19, 2014

CERTIFICATION REGARDING LOBBYING
(31 U.S.C.A. § 1352)
This Certification must be completed, signed, dated and returned to the Galveston County Purchasing Agent

Procurement Number and Description:_____

RFP #B201044, Galveston County Road & Bridge Facility Rebuild Project

Proposer **CERTIFIES**, to the best of its knowledge and belief, that:

1. No Federal appropriated funds have been paid or will be paid, by or on behalf of the proposer, to any person for influencing or attempting to influence an officer or employee of an agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with the awarding of any Federal contract, the making of any Federal grant, the making of any Federal loan, the entering into of any cooperative agreement, and the extension, continuation, renewal, amendment, or modification of any Federal contract, grant, loan, or cooperative agreement.

2. If any funds other than Federal appropriated funds have been paid or will be paid to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with this Federal contract, grant, loan, or cooperative agreement, the proposer shall complete and submit **Standard Form LLL**, "Disclosure Form to Report Lobbying", in accordance with its instructions.

3. Proposer shall require that the language of this certification be included in the award documents for all subawards at all tiers (including subcontracts, subgrants, and contracts under grants, loans, and cooperative agreements) and that all subrecipients shall certify and disclose accordingly.

This certification is a material representation of fact upon which reliance was placed when this transaction was made or entered into. Submission of this certification is a prerequisite for making or entering into this transaction imposed by Section 1352, Title 31, U.S. Code. Any person who fails to file the required certification shall be subject to a civil penalty of not less than $10,000 and not more than $100,000 for each such failure.

Name of Organization/Corporation:_____

Address:_____

City: _____ State:_____ Zip Code:_____

Signature of Authorized Signatory for Proposer:_____ Date Signed:_____

Title of Authorized Signatory of Proposer:_____

State of Texas §
§
County of Galveston §

NON-COLLUSION AFFIDAVIT

Before me, the undersigned notary, on this day personally appeared _____ (Affiant), whom being first duly sworn, deposes and certifies that:

- Affiant is the _____ of _____, that
  (Individual, Partner, Corporate Officer) (Name of Qualifier)
  submitted the attached Qualification in **RFP #B201044, Galveston County Road & Bridge Facility Rebuild Project**

- Affiant is a duly authorized representative of Qualifier and is authorized to make this Non-Collusion Affidavit;

- The attached Qualification is genuine and is not a collusive or sham Qualification;

- The attached Qualification has been independently arrived at without collusion with any other qualifier, bidder, proposer, person, firm, competitor, or potential competitor;

- Qualifier has not colluded, conspired, connived or agreed, directly or indirectly, with any other qualifier, bidder, proposer, person, firm, competitor, or potential competitor, to submit a collusive or sham qualification or that such other qualifier, bidder, proposer, person, firm, competitor, or potential competitor shall refrain from qualifying;

- Qualifier has not in any manner, directly or indirectly, sought by agreement or collusion or communication or conference with any other qualifier, bidder, proposer, person, firm, competitor, or potential competitor to fix the price or prices in the attached Qualification or of the qualification any other qualifier;

- Qualifier has not in any manner, directly or indirectly, sought by agreement or collusion or communication or conference with any other qualifier bidder, proposer, person, firm, competitor, or potential competitor to fix the overhead, profit or cost element of the Qualification price or prices of any other qualifier, or to secure through any collusion, conspiracy, connivance, or unlawful agreement any advantage against Galveston County or any person interested in the proposed contract;

- Affiant has not in any manner, directly or indirectly, sought by agreement or collusion or communication or conference with any other qualifier, bidder, proposer, person, firm, competitor, or potential competitor, paid or agreed to pay any other qualifier, bidder, proposer, person, firm, competitor, or potential competitor any money or anything of value in return for assistance in procuring or attempting to procure a contract or in return for establishing the price or prices in the attached Qualification or the qualification of any other Qualifier; and

- Affiant certifies that Affiant is fully informed regarding the accuracy of the statements contained herein, and under penalties of perjury, certifies and affirms the truth of the statements herein, such penalties being applicable to the Qualifier as well as to Affiant signing on its behalf.

_____
Signature of Affiant

SWORN TO and **SUBSCRIBED** before me this _____day of_____, _____.

_____
Notary Public

My Commission Expires: _____

ITB #B201044
OPEN: 10/15/2020
TIME: 2:15 P.M.

PROPOSAL FORM
GALVESTON COUNTY ROAD & BRIDGE FACILITY REBUILD PROJECT
COUNTY OF GALVESTON, TEXAS

By signing here, the firm does hereby attest that it has fully read the instructions, conditions and general and special provisions and understands them.

THE COMPANY OF: _____

ADDRESS: _____

_____

FEIN (TAX ID): _____

The following shall be returned with your proposal. Failure to do so may be ample cause for rejection of proposal as non- responsive. It is the responsibility of the Proposer to ensure that proposer has received all addenda.

Items:	**Confirmed (X):**
1. References (if required)	_____
2. Addenda, if any	**#1**_____ **#2**____ **#3**____ **#4** ___
3. One (1) original and three (3) copies of submittal	_____
4. Proposal Form	_____
5. Vendor Qualification Packet	_____
6. Debarment Certification Form	_____
7. Non-Collusion Affidavit	_____
8. Payment Terms:	_____**net 30** _____**Other**
9. Lobbyist Certification	_____
10. Proposal Bond	_____

Person to contact regarding this proposal: _____

Title: _____ Phone: _____ Fax: _____

E-mail address: _____

Name of person authorized to bind the Firm: _____

Signature: _____ Date: _____

Title: _____ Phone: _____ Fax: _____

E-mail address: _____

ITB #B201044
OPEN: 10/15/2020
TIME: 2:15 P.M.

PROPOSAL FORM
GALVESTON COUNTY ROAD & BRIDGE FACILITY REBUILD PROJECT
GALVESTON COUNTY, TEXAS

Proposer shall use this form to provide the information for notice.

1. Contact information for notice:

   Name:_____
   Address:_____
   _____
   Telephone Number:_____ Facsimile number:_____

2. If a copy of notice is requested, please complete below:

   Name:_____
   Address:_____
   _____
   Telephone Number:_____ Facsimile number:_____

3. If second or more copies are requested for notice, please supplement this form and clearly mark the supplement as "Supplementary Notice Information."

   Proposer to submit reference information. Proposer shall use this form to provide minimum required reference information. If Proposer wishes to provide more than the minimum, Proposer should supplement this form and should clearly mark the supplement as "Supplementary Reference Information."

1. References who can attest to the Proposer's capability to carry out the requirements set forth in this proposal:

   Business Name of Organization:_____
   Name of Person:_____
   Title of Individual within Organization, if applicable_____
   Business address:_____
   _____
   Telephone number:_____ Facsimile number:_____

   Business Name of Organization:_____
   Name of Person:_____
   Title of Individual within Organization, if applicable_____
   Business address:_____
   _____
   Telephone number:_____ Facsimile number:_____

   Business Name of Organization:_____
   Name of Person:_____
   Title of Individual within Organization, if applicable_____
   Business address:_____
   _____
   Telephone number:_____ Facsimile number:_____

ITB #B201044
OPEN: 10/15/2020
TIME: 2:15 P.M.

PROPOSAL FORM
GALVESTON COUNTY ROAD & BRIDGE FACILITY REBUILD PROJECT
GALVESTON COUNTY, TEXAS

References of major supplier of Proposer who can speak to the financial capability of the Proposer to carry out the requirements set forth in this proposal:

1. Business Name of Supplier_____
   Name of Person:_____
   Title of Individual within business:_____
   Business address:_____
   _____
   Telephone number:_____ Facsimile number:_____

2. Business Name of Supplier_____
   Name of Person:_____
   Title of Individual within business:_____
   Business address:_____
   _____
   Telephone number:_____ Facsimile number:_____

3. Business Name of Supplier_____
   Name of Person:_____
   Title of Individual within business:_____
   Business address:_____
   _____
   Telephone number:_____ Facsimile number:_____

The remainder of this page intentionally left blank

County of Galveston

ACKNOWLEDGMENT AND CERTIFICATION REGARDING DEBARMENT, SUSPENSION, AND OTHER INELGIBILITY

Executive Orders 12549 & 12689 Certification, Debarment and Suspension

Solicitation Number: RFP #B201044

Solicitation Title: Galveston County Road & Bridge Facility Rebuild Project

Contractor hereby CERTIFIES that:

Contractor, and all of its principals, is not presently debarred, suspended, proposed for debarment, proposed for suspension, or declared ineligible under Executive Order 12549 or Executive Order 12689, Debarment and Suspension, and is not in any other way ineligible for participation in Federal or State assistance programs;

Contractor, and all of its principals, were not and have not been debarred, suspended, proposed for debarment, proposed for suspension, or declared ineligible under Executive Order 12549 or Executive Order 12689, Debarment and Suspension, and were not and have not been in any other way ineligible for participation in Federal or State assistance programs at the time its' proposal was submitted in the procurement identified herein and at any time since submission of its' proposal;

Contractor has included, and shall continue to include, this certification in all contracts between itself and any sub-contractors in connection with services performed under this contract; **and**

Contractor shall notify Galveston County in writing immediately, through written notification to the Galveston County Purchasing Agent, if Contractor is not in compliance with Executive Order 12549 or 12689 during the term of its contract with Galveston County.

Contractor **Represents** and **Warrants** that the individual executing this Acknowledgment and Certification on its behalf has the full power and authority to do so and can legally bind the Contractor hereto.

_____	_____
Name of Business	Date
By:_____	_____
Signature	Printed Name & Title

County of Galveston
Purchasing Department
Vendor Qualification Packet

(rev. 1.4, September 28, 2017)

All interested parties seeking consideration for qualified vendor status with the County of Galveston **should complete and return only the following forms to:**

Galveston County Purchasing Department
722 Moody Avenue, (21st Street), 5th Floor
Galveston, Texas 77550
(409) 770-5371 ***office***
(409) 621-7987 ***fax***

PEID Form: **Person /Entity Information Data**

W -9 Form: Request for Taxpayer Identification Number and Certification
(please note that the included form may not be the latest revised form issued by the Internal Revenue Service. *Please check the IRS website at* http://www.irs.gov/publirs-rdf/fw9.pdf *for the latest revision of this form.)*

CIQ Form: **Conflict of Interest Questionnaire**
(please note that the included form may not be the latest revised form issued by the State of Texas Ethics Commission. *Please check the Texas Ethics Commission website at* http://www.ethics.state.tx.us/whatsnew/conflict_forms.htm *for the latest revision of this form. Please note that Galveston County Purchasing Agent is not responsible for the filing of this form with the Galveston County Clerk per instructions of the State of Texas Ethics Commission).*

Debarment: **CERTIFICATION REGARDING DEBARMENT, SUSPENSION, PROPOSED DEBARMENT, AND OTHER RESPONSIBILITY MATTERS & REQUIREMENT TO REGISTER IN SAM**
Vendors/contractor certifies that neither it, nor any of its Principals, are presently debarred, suspended, proposed for debarment, disqualified, excluded, or in any way declared ineligible for the award of contracts by any Federal agency. Vendor agrees that it shall refund Galveston County for any payments made to Contractor while ineligible. Vendor acknowledges that Contractor's uncured failure to perform under any agreement with the County of Galveston, if such should occur, may result in Contractor being debarred from performing additional work for the County, the respecting State Agency administering the grant funding the contract, if applicable, the State, FEMA or HUD (as applicable), and other Federal and State entities. Further, Vendor has executed the Certification Regarding Debarment, Suspension, Proposed Debarment, and Other Responsibility Matters and returned the fully completed and executed original certification with the submission of this Vendor Qualification Packet. ***The truthful and fully completed and executed original of the Certification Regarding Debarment, Suspension, Proposed Debarment, and Other Responsibility Matters must be included with the submission of this Vendor Qualification Packet and is a mandatory requirement to become a vendor of Galveston County. Vendor's failure to include the fully completed and executed original of this Certification shall be considered non-compliant with the requirements of this vendor qualification request and grounds for the rejection of vendor's request.*** *Vendor shall immediately notify the County Purchasing Agent if it becomes debarred or suspended, placed on*

the Consolidated List of Debarred Contractors, or in any other way becomes ineligible for award of contract by any Federal agency. This Certification is a material fact relied upon by Galveston County; i fit is later determined that the vendor did not comply with 2 C. F. R. Part 180 and 2 C.F.R. Part 3000, in additional to the remedies available to Galveston County and the State agency administering a grant, the Federal Government may pursue available remedies, including but not limited to suspension and/or debarment of contractor. If the contract to be awarded pursuant to a Galveston County procurement effort involves the use of Federal funds, then vendor must also be registered in the Federal Contractor Registry through the System for Award Management (SAM) to be eligible for award of contract pursuant to the procurement.
Information regarding the SAM is available at:
http://federalcontractorregistry.com/?gclid=CIGlhf2rr8wCFYkCaQoducANZw or at
http://sam.gov/portal/SAM/#1.

No contract involving the use of Federal funds may be awarded to any vendor unless and until such registration is current and in good standing under SAM Successful vendors must maintain SAM registration throughout the entire term of any contractual agreement with the County. If a contract involves the use of Federal funds, then vendor must enclose proof of such SAM registration within its response, which is also a mandatory requirement of County procurement policy; failure to enclose such proof shall be considered non-compliant with the requirements of any procurement effort and grounds for the rejection of vendor's response to any procurement efforts (i.e., bid, proposal, or qualifications statement, as applicable).

Direct Deposit: Direct Deposit Authorization Form – Temporarily suspended until further notice

Certificate(s) of Insurance: <u>If the person or entity seeking qualified vendor status with the County will be performing work at or on any County owned facility and/or property, Certificate(s) of Insurance are required to be submitted prior to performing any work.</u>

Insurance requirements are as follows:

<u>Public Liability and Property Damage Insurance:</u>

Successful vendor agrees to keep in full force and effect, a policy of public liability and property damage insurance issued by a casualty company authorized to do business in the State of Texas, and in standard form approved by the Board of Insurance Commissioners of the State of Texas, with coverage provisions insuring the public from any loss or damage that may arise to any person or property by reason of services rendered by vendor. Vendor shall at its own expense be required to carry the following minimum insurance coverages:

1. For damages arising out of bodily injury to or death of one person in anyone occurrence - one hundred thousand and no/100 dollars ($100,000.00);
2. For damages arising out of bodily injury to or death of two or more persons in anyone occurrence - three hundred thousand and no/100 dollars ($300,000.00); and
3. For injury to or destruction of property in anyone occurrence - one hundred thousand and no/100 dollars ($100,000.00).

This insurance shall be either on an occurrence basis or on a claims made basis. Provided however, that if the coverage is on a claims made basis, then the vendor shall be required to purchase, at the termination of this agreement, tail coverage for the County for the period of the County's relationship with the vendor under this agreement. Such coverage shall be in the amounts set forth in subparagraphs (1), (2), and (3) above.

Worker's Compensation Insurance:

Successful vendor shall also carry in full force Workers' Compensation Insurance policy(ies), if there is more than one employee, for all employees, including but not limited to full time, part time, and emergency employees employed by the vendor. Current insurance certificates certifying that such policies as specified above are in full force and effect shall be furnished by the vendor to the County.

The County of Galveston shall be named as additional insured on policies listed in subparagraphs above and shall be notified of any changes to the policy(ies) during the contractual period.
Insurance is to be placed with insurers having a Best rating of no less than A. The vendor shall furnish the County with certificates of insurance and original endorsements affecting coverage required by these insurance clauses. The certificates and endorsements for each insurance policy are to be signed by a person authorized by the insurer to bind coverage on its behalf. The vendor shall be required to submit annual renewals for the term of any contractual agreement, purchase order or term contract, with Galveston County prior to expiration of any policy.

In addition to the remedies stated herein, the County has the right to pursue other remedies permitted by law or in equity.

The County agrees to provide vendor with reasonable and timely notice of any claim, demand, or cause of action made or brought against the County arising out of or related to utilization of the property. Vendor shall have the right to defend any such claim, demand, or cause of action at its sole cost and expense and within its sole and exclusive discretion. The County agrees not to compromise or settle any claim or cause of action arising out of or related to the utilization of the property without the prior written consent of the vendor.

In no event shall the County be liable for any damage to or destruction of any property belonging to the vendor unless specified in writing and agreed upon by both parties.

Procurement Policy - Special Note:

Understand that it is, according to Texas Local Government Code, Section 262.011, Purchasing Agents, subsections (d), (e), and (0, the sole responsibility of the Purchasing Agent to supervise all procurement transactions.

Therefore, be advised that all procurement transactions require proper authorization in the form of a Galveston County purchase order from the Purchasing Agent's office prior to commitment to deliver supplies, materials, equipment, including contracts for repair, service, and maintenance agreements. Any commitments made without proper authorization from the Purchasing Agent's office, pending Commissioners' Court approval, may become the sole responsibility of the individual making the commitment including the obligation of payment.

Code of Ethics - Statement of Purchasing Policy:

Public employment is a public trust. It is the policy of Galveston County to promote and balance the objective of protecting the County's integrity and the objective of facilitating the recruitment and retention of personnel needed by Galveston County. Such policy is implemented by prescribing essential standards of ethical conduct without creating unnecessary obstacles to entering public office.

Public employees must discharge their duties impartially so as to assure fair competitive access to governmental procurement by responsible contractors. Moreover, they should conduct themselves in such a manner as to foster public confidence in the integrity of the Galveston County procurement organization.

To achieve the purpose of these instructions, it is essential that those doing business with Galveston County also observe the ethical standards prescribed here.

General Ethical Standards: It shall be a breach of ethics to attempt to realize personal gain through public employment with Galveston County by any conduct inconsistent with the proper discharge of the employee's duties.

It shall be a breach of ethics to attempt to influence any public employee of Galveston County to breach the standards of ethical conduct set forth in this code.

It shall be a breach of ethics for any employee of Galveston County to participate directly or indirectly in procurement when the employee knows that:

- The employee or any member of the employee's immediate family has a financial interest pertaining to the procurement.
- A business or organization in which the employee, or any member of the employee's immediate family, has a financial interest pertaining to the procurement.
- Any other person, business or organization with which the employee or any member of the employee's immediate family is negotiating or has an arrangement concerning prospective employment is involved in the procurement.

Gratuities: It shall be a breach of ethics to offer, give or agree to give any employee of Galveston County, or for any employee or former employee of Galveston County to solicit, demand, accept or agree to accept from another person, a gratuity or an offer of employment in connection with any decision, approval, disapproval, recommendation, preparation of any part of a program requirement or purchase request, influencing the content of any specification or procurement standard, rendering of advice, investigation, auditing, or in any other advisory capacity in any program requirement or a contract or subcontract, or to any solicitation or proposal therefore pending before this government.

Kickbacks: It shall be a breach of ethics for any payment, gratuity or offer of employment to be made by or on behalf of a subcontractor under a contract to the prime contractor or higher tier subcontractor for any contract for Galveston County, or any person associated therewith, as an inducement for the award of a subcontract or order.

Contract Clause: The prohibition against gratuities and kickbacks prescribed above shall be conspicuously set forth in every contract and solicitation by Galveston County.

Confidential Information: It shall be a breach of ethics for any employee or former employee of Galveston County to knowingly use confidential information for actual or anticipated personal gain, or for the actual or anticipated gain of any person.

Questions/Concerns:
If you have any questions or concerns regarding the information or instructions contained within this packet, please contact any member of the Purchasing Department staff at **(409) 770-5371.**

CONFLICT OF INTEREST DISCLOSURE REPORTING

Proposer may be required under Chapter 176 of the Texas Local Government Code to complete and file a conflict of interest questionnaire (CIQ Form). If so, the completed CIQ Form must be filed with the County Clerk of Galveston County, Texas.

If Proposer has an employment or other business relationship with an officer of Galveston County or with a family member of an officer of Galveston County that results in the officer or family member of the officer receiving taxable income that exceeds $2,500.00 during the preceding 12-month period, then Proposer **MUST** complete a CIQ Form and file the original of the CIQ Form with the County Clerk of Galveston County.

If Proposer has given an officer of Galveston County or a family member of an officer of Galveston County one or more gifts with an aggregate value of more than $250.00 during the preceding 12-months, then Proposer **MUST** complete a CIQ Form and file the original of the CIQ Form with the County Clerk of Galveston County

The Galveston County Clerk has offices at the following locations:

Galveston County Clerk
Galveston County Justice Center, Suite 2001
600 59th Street
Galveston, Texas 77551

Galveston County Clerk
North County Annex, 1st Floor
174 Calder Road
League City, Texas 77573

Again, if Proposer is required to file a CIQ Form, the original completed form is filed with the Galveston County Clerk (not the Purchasing Agent).

For Proposer's convenience, a blank CIQ Form is enclosed with this proposal. Blank CIQ Forms may also be obtained by visiting the Galveston County Clerk's website and/or the Purchasing Agent's website - both of these web sites are linked to the Galveston County homepage at http://www.galvestoncountytx.gov

As well, blank CIQ Forms may be obtained by visiting the Texas Ethics Commission website, specifically at http://www.ethics.state.tx.us/whatsnew/conflictfroms.htm

Chapter 176 specifies deadlines for the filing of CIQ Forms (both initial filings and updated filings).

It is Proposer's sole responsibility to file a true and complete CIQ Form with the Galveston County Clerk if Proposer is required to file by the requirements of Chapter 176. Proposer is advised that it is an offense to fail to comply with the disclosure reporting requirements dictated under Chapter 176 of the Texas Local Government Code.

If you have questions about compliance with Chapter 176, please consult your own legal counsel. Compliance is the individual responsibility of each person, business, and agent who is subject to Chapter 176 of the Texas Local Government Code.

COUNTY of GALVESTON
Purchasing Department

rev. 1.3, March 29, 2010

FORM PEID:	**Request for Person-Entity Identification Data**

Instructions: Please type or print clearly when completing sections 1 thru 4 and return completed form to:

Galveston County Purchasing Agent
722 Moody Avenue (21 st. Street), 5th Floor
Galveston, Texas 77550
(409) 770-5371
prodoc@co.galveston.tx.us

1.

Business Name:	
Attention Line:	

2.

Physical Address:			
City:		**State:**	**Zip+4:**

3.

Billing / Remit Address:			
City:		**State:**	**Zip+4**

4.

Main Contact Person:	
Main Phone Number:	
Fax Number:	
E-mail Address:	

Areas below are for County use only.

Requested By:	**Phone / Ext. #**
Department:	**Date:**

Action Requested - Check One:	**IFAS PEID Vendor Number:**	
( ) Add New	( ) Change Data	( ) Re-activate
( ) Inactivate	( ) Employee	( ) Attorney
( ) Landlord	( ) Foster Parent	( ) Refund
( ) OneTime	( ) Foster Child	

Form **W-9**
(Rev. October 2018)
Department of the Treasury
Internal Revenue Service

Request for Taxpayer Identification Number and Certification

▶ Go to *www.irs.gov/FormW9* for instructions and the latest information.

Give Form to the requester. Do not send to the IRS.

Print or type. See Specific Instructions on page 3.

1 Name (as shown on your income tax return). Name is required on this line; do not leave this line blank.

2 Business name/disregarded entity name, if different from above

3 Check appropriate box for federal tax classification of the person whose name is entered on line 1. Check only **one** of the following seven boxes.

☐ Individual/sole proprietor or single-member LLC ☐ C Corporation ☐ S Corporation ☐ Partnership ☐ Trust/estate

☐ Limited liability company. Enter the tax classification (C=C corporation, S=S corporation, P=Partnership) ▶ _____

Note: Check the appropriate box in the line above for the tax classification of the single-member owner. Do not check LLC if the LLC is classified as a single-member LLC that is disregarded from the owner unless the owner of the LLC is another LLC that is **not** disregarded from the owner for U.S. federal tax purposes. Otherwise, a single-member LLC that is disregarded from the owner should check the appropriate box for the tax classification of its owner.

☐ Other (see instructions) ▶

4 Exemptions (codes apply only to certain entities, not individuals; see instructions on page 3):

Exempt payee code (if any) _____

Exemption from FATCA reporting code (if any) _____

(Applies to accounts maintained outside the U.S.)

5 Address (number, street, and apt. or suite no.) See instructions.

Requester's name and address (optional)

6 City, state, and ZIP code

7 List account number(s) here (optional)

Part I Taxpayer Identification Number (TIN)

Enter your TIN in the appropriate box. The TIN provided must match the name given on line 1 to avoid backup withholding. For individuals, this is generally your social security number (SSN). However, for a resident alien, sole proprietor, or disregarded entity, see the instructions for Part I, later. For other entities, it is your employer identification number (EIN). If you do not have a number, see *How to get a TIN,* later.

Note: If the account is in more than one name, see the instructions for line 1. Also see *What Name and Number To Give the Requester* for guidelines on whose number to enter.

Social security number

☐☐☐ – ☐☐ – ☐☐☐☐

or

Employer identification number

☐☐ – ☐☐☐☐☐☐☐

Part II Certification

Under penalties of perjury, I certify that:

1. The number shown on this form is my correct taxpayer identification number (or I am waiting for a number to be issued to me); and
2. I am not subject to backup withholding because: (a) I am exempt from backup withholding, or (b) I have not been notified by the Internal Revenue Service (IRS) that I am subject to backup withholding as a result of a failure to report all interest or dividends, or (c) the IRS has notified me that I am no longer subject to backup withholding; and
3. I am a U.S. citizen or other U.S. person (defined below); and
4. The FATCA code(s) entered on this form (if any) indicating that I am exempt from FATCA reporting is correct.

Certification instructions. You must cross out item 2 above if you have been notified by the IRS that you are currently subject to backup withholding because you have failed to report all interest and dividends on your tax return. For real estate transactions, item 2 does not apply. For mortgage interest paid, acquisition or abandonment of secured property, cancellation of debt, contributions to an individual retirement arrangement (IRA), and generally, payments other than interest and dividends, you are not required to sign the certification, but you must provide your correct TIN. See the instructions for Part II, later.

Sign Here **Signature of U.S. person ▶** **Date ▶**

General Instructions

Section references are to the Internal Revenue Code unless otherwise noted.

Future developments. For the latest information about developments related to Form W-9 and its instructions, such as legislation enacted after they were published, go to *www.irs.gov/FormW9.*

Purpose of Form

An individual or entity (Form W-9 requester) who is required to file an information return with the IRS must obtain your correct taxpayer identification number (TIN) which may be your social security number (SSN), individual taxpayer identification number (ITIN), adoption taxpayer identification number (ATIN), or employer identification number (EIN), to report on an information return the amount paid to you, or other amount reportable on an information return. Examples of information returns include, but are not limited to, the following.

- Form 1099-INT (interest earned or paid)
- Form 1099-DIV (dividends, including those from stocks or mutual funds)
- Form 1099-MISC (various types of income, prizes, awards, or gross proceeds)
- Form 1099-B (stock or mutual fund sales and certain other transactions by brokers)
- Form 1099-S (proceeds from real estate transactions)
- Form 1099-K (merchant card and third party network transactions)
- Form 1098 (home mortgage interest), 1098-E (student loan interest), 1098-T (tuition)
- Form 1099-C (canceled debt)
- Form 1099-A (acquisition or abandonment of secured property)

Use Form W-9 only if you are a U.S. person (including a resident alien), to provide your correct TIN.

If you do not return Form W-9 to the requester with a TIN, you might be subject to backup withholding. See What is backup withholding, *later.*

By signing the filled-out form, you:

1. Certify that the TIN you are giving is correct (or you are waiting for a number to be issued),

2. Certify that you are not subject to backup withholding, or

3. Claim exemption from backup withholding if you are a U.S. exempt payee. If applicable, you are also certifying that as a U.S. person, your allocable share of any partnership income from a U.S. trade or business is not subject to the withholding tax on foreign partners' share of effectively connected income, and

4. Certify that FATCA code(s) entered on this form (if any) indicating that you are exempt from the FATCA reporting, is correct. See *What is FATCA reporting,* later, for further information.

Note: If you are a U.S. person and a requester gives you a form other than Form W-9 to request your TIN, you must use the requester's form if it is substantially similar to this Form W-9.

Definition of a U.S. person. For federal tax purposes, you are considered a U.S. person if you are:

- An individual who is a U.S. citizen or U.S. resident alien;
- A partnership, corporation, company, or association created or organized in the United States or under the laws of the United States;
- An estate (other than a foreign estate); or
- A domestic trust (as defined in Regulations section 301.7701-7).

Special rules for partnerships. Partnerships that conduct a trade or business in the United States are generally required to pay a withholding tax under section 1446 on any foreign partners' share of effectively connected taxable income from such business. Further, in certain cases where a Form W-9 has not been received, the rules under section 1446 require a partnership to presume that a partner is a foreign person, and pay the section 1446 withholding tax. Therefore, if you are a U.S. person that is a partner in a partnership conducting a trade or business in the United States, provide Form W-9 to the partnership to establish your U.S. status and avoid section 1446 withholding on your share of partnership income.

In the cases below, the following person must give Form W-9 to the partnership for purposes of establishing its U.S. status and avoiding withholding on its allocable share of net income from the partnership conducting a trade or business in the United States.

- In the case of a disregarded entity with a U.S. owner, the U.S. owner of the disregarded entity and not the entity;
- In the case of a grantor trust with a U.S. grantor or other U.S. owner, generally, the U.S. grantor or other U.S. owner of the grantor trust and not the trust; and
- In the case of a U.S. trust (other than a grantor trust), the U.S. trust (other than a grantor trust) and not the beneficiaries of the trust.

Foreign person. If you are a foreign person or the U.S. branch of a foreign bank that has elected to be treated as a U.S. person, do not use Form W-9. Instead, use the appropriate Form W-8 or Form 8233 (see Pub. 515, Withholding of Tax on Nonresident Aliens and Foreign Entities).

Nonresident alien who becomes a resident alien. Generally, only a nonresident alien individual may use the terms of a tax treaty to reduce or eliminate U.S. tax on certain types of income. However, most tax treaties contain a provision known as a "saving clause." Exceptions specified in the saving clause may permit an exemption from tax to continue for certain types of income even after the payee has otherwise become a U.S. resident alien for tax purposes.

If you are a U.S. resident alien who is relying on an exception contained in the saving clause of a tax treaty to claim an exemption from U.S. tax on certain types of income, you must attach a statement to Form W-9 that specifies the following five items.

1. The treaty country. Generally, this must be the same treaty under which you claimed exemption from tax as a nonresident alien.

2. The treaty article addressing the income.

3. The article number (or location) in the tax treaty that contains the saving clause and its exceptions.

4. The type and amount of income that qualifies for the exemption from tax.

5. Sufficient facts to justify the exemption from tax under the terms of the treaty article.

Example. Article 20 of the U.S.-China income tax treaty allows an exemption from tax for scholarship income received by a Chinese student temporarily present in the United States. Under U.S. law, this student will become a resident alien for tax purposes if his or her stay in the United States exceeds 5 calendar years. However, paragraph 2 of the first Protocol to the U.S.-China treaty (dated April 30, 1984) allows the provisions of Article 20 to continue to apply even after the Chinese student becomes a resident alien of the United States. A Chinese student who qualifies for this exception (under paragraph 2 of the first protocol) and is relying on this exception to claim an exemption from tax on his or her scholarship or fellowship income would attach to Form W-9 a statement that includes the information described above to support that exemption.

If you are a nonresident alien or a foreign entity, give the requester the appropriate completed Form W-8 or Form 8233.

Backup Withholding

What is backup withholding? Persons making certain payments to you must under certain conditions withhold and pay to the IRS 24% of such payments. This is called "backup withholding." Payments that may be subject to backup withholding include interest, tax-exempt interest, dividends, broker and barter exchange transactions, rents, royalties, nonemployee pay, payments made in settlement of payment card and third party network transactions, and certain payments from fishing boat operators. Real estate transactions are not subject to backup withholding.

You will not be subject to backup withholding on payments you receive if you give the requester your correct TIN, make the proper certifications, and report all your taxable interest and dividends on your tax return.

Payments you receive will be subject to backup withholding if:

1. You do not furnish your TIN to the requester,

2. You do not certify your TIN when required (see the instructions for Part II for details),

3. The IRS tells the requester that you furnished an incorrect TIN,

4. The IRS tells you that you are subject to backup withholding because you did not report all your interest and dividends on your tax return (for reportable interest and dividends only), or

5. You do not certify to the requester that you are not subject to backup withholding under 4 above (for reportable interest and dividend accounts opened after 1983 only).

Certain payees and payments are exempt from backup withholding. See *Exempt payee code,* later, and the separate Instructions for the Requester of Form W-9 for more information.

Also see *Special rules for partnerships,* earlier.

What is FATCA Reporting?

The Foreign Account Tax Compliance Act (FATCA) requires a participating foreign financial institution to report all United States account holders that are specified United States persons. Certain payees are exempt from FATCA reporting. See *Exemption from FATCA reporting code,* later, and the Instructions for the Requester of Form W-9 for more information.

Updating Your Information

You must provide updated information to any person to whom you claimed to be an exempt payee if you are no longer an exempt payee and anticipate receiving reportable payments in the future from this person. For example, you may need to provide updated information if you are a C corporation that elects to be an S corporation, or if you no longer are tax exempt. In addition, you must furnish a new Form W-9 if the name or TIN changes for the account; for example, if the grantor of a grantor trust dies.

Penalties

Failure to furnish TIN. If you fail to furnish your correct TIN to a requester, you are subject to a penalty of $50 for each such failure unless your failure is due to reasonable cause and not to willful neglect.

Civil penalty for false information with respect to withholding. If you make a false statement with no reasonable basis that results in no backup withholding, you are subject to a $500 penalty.

Criminal penalty for falsifying information. Willfully falsifying certifications or affirmations may subject you to criminal penalties including fines and/or imprisonment.

Misuse of TINs. If the requester discloses or uses TINs in violation of federal law, the requester may be subject to civil and criminal penalties.

Specific Instructions

Line 1

You must enter one of the following on this line; **do not** leave this line blank. The name should match the name on your tax return.

If this Form W-9 is for a joint account (other than an account maintained by a foreign financial institution (FFI)), list first, and then circle, the name of the person or entity whose number you entered in Part I of Form W-9. If you are providing Form W-9 to an FFI to document a joint account, each holder of the account that is a U.S. person must provide a Form W-9.

a. **Individual.** Generally, enter the name shown on your tax return. If you have changed your last name without informing the Social Security Administration (SSA) of the name change, enter your first name, the last name as shown on your social security card, and your new last name.

Note: ITIN applicant: Enter your individual name as it was entered on your Form W-7 application, line 1a. This should also be the same as the name you entered on the Form 1040/1040A/1040EZ you filed with your application.

b. **Sole proprietor or single-member LLC.** Enter your individual name as shown on your 1040/1040A/1040EZ on line 1. You may enter your business, trade, or "doing business as" (DBA) name on line 2.

c. **Partnership, LLC that is not a single-member LLC, C corporation, or S corporation.** Enter the entity's name as shown on the entity's tax return on line 1 and any business, trade, or DBA name on line 2.

d. **Other entities.** Enter your name as shown on required U.S. federal tax documents on line 1. This name should match the name shown on the charter or other legal document creating the entity. You may enter any business, trade, or DBA name on line 2.

e. **Disregarded entity.** For U.S. federal tax purposes, an entity that is disregarded as an entity separate from its owner is treated as a "disregarded entity." See Regulations section 301.7701-2(c)(2)(iii). Enter the owner's name on line 1. The name of the entity entered on line 1 should never be a disregarded entity. The name on line 1 should be the name shown on the income tax return on which the income should be reported. For example, if a foreign LLC that is treated as a disregarded entity for U.S. federal tax purposes has a single owner that is a U.S. person, the U.S. owner's name is required to be provided on line 1. If the direct owner of the entity is also a disregarded entity, enter the first owner that is not disregarded for federal tax purposes. Enter the disregarded entity's name on line 2, "Business name/disregarded entity name." If the owner of the disregarded entity is a foreign person, the owner must complete an appropriate Form W-8 instead of a Form W-9. This is the case even if the foreign person has a U.S. TIN.

Line 2

If you have a business name, trade name, DBA name, or disregarded entity name, you may enter it on line 2.

Line 3

Check the appropriate box on line 3 for the U.S. federal tax classification of the person whose name is entered on line 1. Check only one box on line 3.

IF the entity/person on line 1 is a(n) . . .	THEN check the box for . . .
• Corporation	Corporation
• Individual • Sole proprietorship, or • Single-member limited liability company (LLC) owned by an individual and disregarded for U.S. federal tax purposes.	Individual/sole proprietor or single-member LLC
• LLC treated as a partnership for U.S. federal tax purposes, • LLC that has filed Form 8832 or 2553 to be taxed as a corporation, or • LLC that is disregarded as an entity separate from its owner but the owner is another LLC that is not disregarded for U.S. federal tax purposes.	Limited liability company and enter the appropriate tax classification. (P= Partnership; C= C corporation; or S= S corporation)
• Partnership	Partnership
• Trust/estate	Trust/estate

Line 4, Exemptions

If you are exempt from backup withholding and/or FATCA reporting, enter in the appropriate space on line 4 any code(s) that may apply to you.

Exempt payee code.

- Generally, individuals (including sole proprietors) are not exempt from backup withholding.
- Except as provided below, corporations are exempt from backup withholding for certain payments, including interest and dividends.
- Corporations are not exempt from backup withholding for payments made in settlement of payment card or third party network transactions.
- Corporations are not exempt from backup withholding with respect to attorneys' fees or gross proceeds paid to attorneys, and corporations that provide medical or health care services are not exempt with respect to payments reportable on Form 1099-MISC.

The following codes identify payees that are exempt from backup withholding. Enter the appropriate code in the space in line 4.

1—An organization exempt from tax under section 501(a), any IRA, or a custodial account under section 403(b)(7) if the account satisfies the requirements of section 401(f)(2)

2—The United States or any of its agencies or instrumentalities

3—A state, the District of Columbia, a U.S. commonwealth or possession, or any of their political subdivisions or instrumentalities

4—A foreign government or any of its political subdivisions, agencies, or instrumentalities

5—A corporation

6—A dealer in securities or commodities required to register in the United States, the District of Columbia, or a U.S. commonwealth or possession

7—A futures commission merchant registered with the Commodity Futures Trading Commission

8—A real estate investment trust

9—An entity registered at all times during the tax year under the Investment Company Act of 1940

10—A common trust fund operated by a bank under section 584(a)

11—A financial institution

12—A middleman known in the investment community as a nominee or custodian

13—A trust exempt from tax under section 664 or described in section 4947

The following chart shows types of payments that may be exempt from backup withholding. The chart applies to the exempt payees listed above, 1 through 13.

IF the payment is for . . .	THEN the payment is exempt for . . .
Interest and dividend payments	All exempt payees except for 7
Broker transactions	Exempt payees 1 through 4 and 6 through 11 and all C corporations. S corporations must not enter an exempt payee code because they are exempt only for sales of noncovered securities acquired prior to 2012.
Barter exchange transactions and patronage dividends	Exempt payees 1 through 4
Payments over $600 required to be reported and direct sales over $5,000[1]	Generally, exempt payees 1 through 5[2]
Payments made in settlement of payment card or third party network transactions	Exempt payees 1 through 4

[1] See Form 1099-MISC, Miscellaneous Income, and its instructions.

[2] However, the following payments made to a corporation and reportable on Form 1099-MISC are not exempt from backup withholding: medical and health care payments, attorneys' fees, gross proceeds paid to an attorney reportable under section 6045(f), and payments for services paid by a federal executive agency.

Exemption from FATCA reporting code. The following codes identify payees that are exempt from reporting under FATCA. These codes apply to persons submitting this form for accounts maintained outside of the United States by certain foreign financial institutions. Therefore, if you are only submitting this form for an account you hold in the United States, you may leave this field blank. Consult with the person requesting this form if you are uncertain if the financial institution is subject to these requirements. A requester may indicate that a code is not required by providing you with a Form W-9 with "Not Applicable" (or any similar indication) written or printed on the line for a FATCA exemption code.

A—An organization exempt from tax under section 501(a) or any individual retirement plan as defined in section 7701(a)(37)

B—The United States or any of its agencies or instrumentalities

C—A state, the District of Columbia, a U.S. commonwealth or possession, or any of their political subdivisions or instrumentalities

D—A corporation the stock of which is regularly traded on one or more established securities markets, as described in Regulations section 1.1472-1(c)(1)(i)

E—A corporation that is a member of the same expanded affiliated group as a corporation described in Regulations section 1.1472-1(c)(1)(i)

F—A dealer in securities, commodities, or derivative financial instruments (including notional principal contracts, futures, forwards, and options) that is registered as such under the laws of the United States or any state

G—A real estate investment trust

H—A regulated investment company as defined in section 851 or an entity registered at all times during the tax year under the Investment Company Act of 1940

I—A common trust fund as defined in section 584(a)

J—A bank as defined in section 581

K—A broker

L—A trust exempt from tax under section 664 or described in section 4947(a)(1)

M—A tax exempt trust under a section 403(b) plan or section 457(g) plan

Note: You may wish to consult with the financial institution requesting this form to determine whether the FATCA code and/or exempt payee code should be completed.

Line 5

Enter your address (number, street, and apartment or suite number). This is where the requester of this Form W-9 will mail your information returns. If this address differs from the one the requester already has on file, write NEW at the top. If a new address is provided, there is still a chance the old address will be used until the payor changes your address in their records.

Line 6

Enter your city, state, and ZIP code.

Part I. Taxpayer Identification Number (TIN)

Enter your TIN in the appropriate box. If you are a resident alien and you do not have and are not eligible to get an SSN, your TIN is your IRS individual taxpayer identification number (ITIN). Enter it in the social security number box. If you do not have an ITIN, see *How to get a TIN* below.

If you are a sole proprietor and you have an EIN, you may enter either your SSN or EIN.

If you are a single-member LLC that is disregarded as an entity separate from its owner, enter the owner's SSN (or EIN, if the owner has one). Do not enter the disregarded entity's EIN. If the LLC is classified as a corporation or partnership, enter the entity's EIN.

Note: See *What Name and Number To Give the Requester,* later, for further clarification of name and TIN combinations.

How to get a TIN. If you do not have a TIN, apply for one immediately. To apply for an SSN, get Form SS-5, Application for a Social Security Card, from your local SSA office or get this form online at *www.SSA.gov*. You may also get this form by calling 1-800-772-1213. Use Form W-7, Application for IRS Individual Taxpayer Identification Number, to apply for an ITIN, or Form SS-4, Application for Employer Identification Number, to apply for an EIN. You can apply for an EIN online by accessing the IRS website at *www.irs.gov/Businesses* and clicking on Employer Identification Number (EIN) under Starting a Business. Go to *www.irs.gov/Forms* to view, download, or print Form W-7 and/or Form SS-4. Or, you can go to *www.irs.gov/OrderForms* to place an order and have Form W-7 and/or SS-4 mailed to you within 10 business days.

If you are asked to complete Form W-9 but do not have a TIN, apply for a TIN and write "Applied For" in the space for the TIN, sign and date the form, and give it to the requester. For interest and dividend payments, and certain payments made with respect to readily tradable instruments, generally you will have 60 days to get a TIN and give it to the requester before you are subject to backup withholding on payments. The 60-day rule does not apply to other types of payments. You will be subject to backup withholding on all such payments until you provide your TIN to the requester.

Note: Entering "Applied For" means that you have already applied for a TIN or that you intend to apply for one soon.

Caution: A disregarded U.S. entity that has a foreign owner must use the appropriate Form W-8.

Part II. Certification

To establish to the withholding agent that you are a U.S. person, or resident alien, sign Form W-9. You may be requested to sign by the withholding agent even if item 1, 4, or 5 below indicates otherwise.

For a joint account, only the person whose TIN is shown in Part I should sign (when required). In the case of a disregarded entity, the person identified on line 1 must sign. Exempt payees, see *Exempt payee code,* earlier.

Signature requirements. Complete the certification as indicated in items 1 through 5 below.

1. Interest, dividend, and barter exchange accounts opened before 1984 and broker accounts considered active during 1983. You must give your correct TIN, but you do not have to sign the certification.

2. Interest, dividend, broker, and barter exchange accounts opened after 1983 and broker accounts considered inactive during 1983. You must sign the certification or backup withholding will apply. If you are subject to backup withholding and you are merely providing your correct TIN to the requester, you must cross out item 2 in the certification before signing the form.

3. Real estate transactions. You must sign the certification. You may cross out item 2 of the certification.

4. Other payments. You must give your correct TIN, but you do not have to sign the certification unless you have been notified that you have previously given an incorrect TIN. "Other payments" include payments made in the course of the requester's trade or business for rents, royalties, goods (other than bills for merchandise), medical and health care services (including payments to corporations), payments to a nonemployee for services, payments made in settlement of payment card and third party network transactions, payments to certain fishing boat crew members and fishermen, and gross proceeds paid to attorneys (including payments to corporations).

5. Mortgage interest paid by you, acquisition or abandonment of secured property, cancellation of debt, qualified tuition program payments (under section 529), ABLE accounts (under section 529A), IRA, Coverdell ESA, Archer MSA or HSA contributions or distributions, and pension distributions. You must give your correct TIN, but you do not have to sign the certification.

What Name and Number To Give the Requester

For this type of account:	Give name and SSN of:
1. Individual	The individual
2. Two or more individuals (joint account) other than an account maintained by an FFI	The actual owner of the account or, if combined funds, the first individual on the account[1]
3. Two or more U.S. persons (joint account maintained by an FFI)	Each holder of the account
4. Custodial account of a minor (Uniform Gift to Minors Act)	The minor[2]
5. a. The usual revocable savings trust (grantor is also trustee)	The grantor-trustee[1]
b. So-called trust account that is not a legal or valid trust under state law	The actual owner[1]
6. Sole proprietorship or disregarded entity owned by an individual	The owner[3]
7. Grantor trust filing under Optional Form 1099 Filing Method 1 (see Regulations section 1.671-4(b)(2)(i)(A))	The grantor*
For this type of account:	**Give name and EIN of:**
8. Disregarded entity not owned by an individual	The owner
9. A valid trust, estate, or pension trust	Legal entity[4]
10. Corporation or LLC electing corporate status on Form 8832 or Form 2553	The corporation
11. Association, club, religious, charitable, educational, or other tax-exempt organization	The organization
12. Partnership or multi-member LLC	The partnership
13. A broker or registered nominee	The broker or nominee
14. Account with the Department of Agriculture in the name of a public entity (such as a state or local government, school district, or prison) that receives agricultural program payments	The public entity
15. Grantor trust filing under the Form 1041 Filing Method or the Optional Form 1099 Filing Method 2 (see Regulations section 1.671-4(b)(2)(i)(B))	The trust

[1] List first and circle the name of the person whose number you furnish. If only one person on a joint account has an SSN, that person's number must be furnished.

[2] Circle the minor's name and furnish the minor's SSN.

[3] You must show your individual name and you may also enter your business or DBA name on the "Business name/disregarded entity" name line. You may use either your SSN or EIN (if you have one), but the IRS encourages you to use your SSN.

[4] List first and circle the name of the trust, estate, or pension trust. (Do not furnish the TIN of the personal representative or trustee unless the legal entity itself is not designated in the account title.) Also see *Special rules for partnerships,* earlier.

***Note:** The grantor also must provide a Form W-9 to trustee of trust.

Note: If no name is circled when more than one name is listed, the number will be considered to be that of the first name listed.

Secure Your Tax Records From Identity Theft

Identity theft occurs when someone uses your personal information such as your name, SSN, or other identifying information, without your permission, to commit fraud or other crimes. An identity thief may use your SSN to get a job or may file a tax return using your SSN to receive a refund.

To reduce your risk:

- Protect your SSN,
- Ensure your employer is protecting your SSN, and
- Be careful when choosing a tax preparer.

If your tax records are affected by identity theft and you receive a notice from the IRS, respond right away to the name and phone number printed on the IRS notice or letter.

If your tax records are not currently affected by identity theft but you think you are at risk due to a lost or stolen purse or wallet, questionable credit card activity or credit report, contact the IRS Identity Theft Hotline at 1-800-908-4490 or submit Form 14039.

For more information, see Pub. 5027, Identity Theft Information for Taxpayers.

Victims of identity theft who are experiencing economic harm or a systemic problem, or are seeking help in resolving tax problems that have not been resolved through normal channels, may be eligible for Taxpayer Advocate Service (TAS) assistance. You can reach TAS by calling the TAS toll-free case intake line at 1-877-777-4778 or TTY/TDD 1-800-829-4059.

Protect yourself from suspicious emails or phishing schemes. Phishing is the creation and use of email and websites designed to mimic legitimate business emails and websites. The most common act is sending an email to a user falsely claiming to be an established legitimate enterprise in an attempt to scam the user into surrendering private information that will be used for identity theft.

The IRS does not initiate contacts with taxpayers via emails. Also, the IRS does not request personal detailed information through email or ask taxpayers for the PIN numbers, passwords, or similar secret access information for their credit card, bank, or other financial accounts.

If you receive an unsolicited email claiming to be from the IRS, forward this message to *phishing@irs.gov*. You may also report misuse of the IRS name, logo, or other IRS property to the Treasury Inspector General for Tax Administration (TIGTA) at 1-800-366-4484. You can forward suspicious emails to the Federal Trade Commission at *spam@uce.gov* or report them at *www.ftc.gov/complaint*. You can contact the FTC at *www.ftc.gov/idtheft* or 877-IDTHEFT (877-438-4338). If you have been the victim of identity theft, see *www.IdentityTheft.gov* and Pub. 5027.

Visit *www.irs.gov/IdentityTheft* to learn more about identity theft and how to reduce your risk.

Privacy Act Notice

Section 6109 of the Internal Revenue Code requires you to provide your correct TIN to persons (including federal agencies) who are required to file information returns with the IRS to report interest, dividends, or certain other income paid to you; mortgage interest you paid; the acquisition or abandonment of secured property; the cancellation of debt; or contributions you made to an IRA, Archer MSA, or HSA. The person collecting this form uses the information on the form to file information returns with the IRS, reporting the above information. Routine uses of this information include giving it to the Department of Justice for civil and criminal litigation and to cities, states, the District of Columbia, and U.S. commonwealths and possessions for use in administering their laws. The information also may be disclosed to other countries under a treaty, to federal and state agencies to enforce civil and criminal laws, or to federal law enforcement and intelligence agencies to combat terrorism. You must provide your TIN whether or not you are required to file a tax return. Under section 3406, payers must generally withhold a percentage of taxable interest, dividend, and certain other payments to a payee who does not give a TIN to the payer. Certain penalties may also apply for providing false or fraudulent information.

CONFLICT OF INTEREST QUESTIONNAIRE

FORM CIQ

For vendor or other person doing business with local governmental entity

This questionnaire reflects changes made to the law by H.B. 1491, 80th Leg., Regular Session.

This questionnaire is being filed in accordance with Chapter 176, Local Government Code by a person who has a business relationship as defined by Section 176.001 (1-a) with a local governmental entity and the person meets requirements under Section 176.006(a).

By law this questionnaire must be filed with the records administrator of the local governmental entity not later than the 7th business day after the date the person becomes aware of facts that require the statement to be filed. *See* Section 176.006, Local Government Code.

A person commits an offense if the person knowingly violates Section 176.006, Local Government Code. An offense under this section is a Class C misdemeanor.

OFFICE USE ONLY

Date Received

1 **Name of person who has a business relationship with local governmental entity.**

2 ☐ **Check this box if you are filing an update to a previously filed questionnaire.**

(The law requires that you file an updated completed questionnaire with the appropriate filing authority not later than the 7th business day after the date the originally filed questionnaire becomes incomplete or inaccurate.)

3 **Name of local government officer with whom filer has employment or business relationship.**

Name of Officer

This section (item 3 including subparts A, B, C & D) must be completed for each *officer* with whom the filer has an employment or other business relationship as defined by Section 176.001 (1-a), Local Government Code. Attach additional pages to this Form CIQ as necessary.

A. Is the local government officer named in this section receiving or likely to receive taxable income, other than investment income, from the filer of the questionnaire?

☐ Yes ☐ NO

B. Is the filer of the questionnaire receiving or likely to receive taxable income, other than investment income, from or at the direction of the local government *officer* named in this section AND the taxable income is not received from the local governmental entity?

☐ Yes ☐ NO

C. Is the filer of this questionnaire employed by a corporation or other business entity with respect to which the local government officer serves as an *officer* or director, or holds an ownership of 10 percent or more?

☐ Yes ☐ NO

D. Describe each employment or business relationship with the local government *officer* named in this section.

4

Signature of person doing business with the governmental entity

Date

Adopted *06/29/2007*

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Project Manual

Galveston County

Road & Bridge Department Facilities

5115 TX-3
Dickinson, Texas 77539

95% CONSTRUCTION DOCUMENTS

June 8, 2020

Page Project No. 418198

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DOCUMENT 003132 - GEOTECHNICAL DATA

1.1 GEOTECHNICAL DATA

A. This Document with its referenced attachments is part of the Procurement and Contracting Requirements for Project. They provide Owner's information for Bidders' convenience and are intended to supplement rather than serve in lieu of Bidders' own investigations. They are made available for Bidders' convenience and information. This Document and its attachments are not part of the Contract Documents.

B. Because subsurface conditions indicated by the soil borings are a sampling in relation to the entire construction area, and for other reasons, the Owner, the Architect, the Architect's consultants, and the firm reporting the subsurface conditions do not warranty the conditions below the depths of the borings or that the strata logged from the borings are necessarily typical of the entire site. Any party using the information described in the soil borings and geotechnical report shall accept full responsibility for its use.

C. A geotechnical investigation report for Project, prepared by Earth Engineering, Inc., dated November 4, 2019, is available for viewing as appended to this Document.

1. The opinions expressed in this report are those of a geotechnical engineer and represent interpretations of subsoil conditions, tests, and results of analyses conducted by a geotechnical engineer. Owner is not responsible for interpretations or conclusions drawn from the data.
2. Any party using information described in the geotechnical report shall make additional test borings and conduct other exploratory operations that may be required to determine the character of subsurface materials that may be encountered.

END OF DOCUMENT 003132

GEOTECHNICAL EXPLORATION REPORT
THE PROPOSED GALVESTON COUNTY ROAD AND BRIDGE FACILITY
IN DICKENSON, TEXAS

Reported to

MS. WENDY HEGER AIA, LEED AP BD+C, WELL AP
PAGE.

Prepared By

down to earth solutions
for your complex projects

EARTH ENGINEERING, INC.
HOUSTON, TEXAS

1996 - 2019
23
YEARS OF EXCELLENCE
Earth Engineering, Inc.

Project No: EE-1919908-G

November 4, 2019

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November 4, 2019

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Principal / Houston Civic Director / Client Development
1100 Louisiana St. Ste. One
Houston, TX 77002

Report No.: EE-1919908-G

Subject: **GEOTECHNICAL EXPLORATION REPORT FOR THE PROPOSED GALVESTON COUNTY ROAD AND BRIDGE FACILITY IN DICKENSON, TEXAS**

Dear Ms. Heger:

Earth Engineering, Inc. is pleased to submit the results of the geotechnical exploration study for the above-referenced project. This report briefly presents the findings of the study along with our conclusions and recommendations for the design of the foundation for the above project.

We appreciate the opportunity to serve you and look forward to working with you in other future projects. We also look forward to providing the materials testing inspection phase on this project.

Should you have any questions regarding this report or any questions pertaining to soils engineering or materials testing, please do not hesitate to call me at (713) 681-5311 or email me at moes@eartheng.com at any time.

Yours very truly,
EARTH ENGINEERING, INC.

Haitam Alageli, MSc.
Geotechnical Engineer

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Earth Engineering, Inc # F-5045

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1.0 INTRODUCTION

Planning is underway for construction for Galveston County Road and Bridge Facility located at Mowat Drive in Dickenson, TX.

A total of six (6) one story steel frame buildings with associated pavement will be constructed at the site location.

At the time of our geotechnical exploration. Several exiting buildings and parking were observed at the east side of the site. The west side was vacant partially wooded.

A truck mounted rig was utilized to drill the borings.

2.0 SCOPE OF WORK

The scope of our services was provided by the client:

- Drilling and sampling three (3) borings to a depth of 30-feet at the proposed buildings areas.
- Drilling and sampling two (2) borings to a depth of 40-feet at the proposed buildings areas.
- Drilling and sampling three (3) borings to a depth of 5-feet at the proposed parking areas.
- Obtaining continuous soil samples to a depth of ten (12) feet, and then at five (5) foot intervals thereafter to the borings' termination depths.
- Earth Engineering will perform granular soil sampling utilizing the Standard Penetration Test (split spoon sampler) by driving. Blow counts will be recorded as produced by a 140-pound weight falling 30 inches (ASTM D-1558). Cohesive soils will be sampled using a thin walled sampler (Shelby Tube) hydraulically pushed into the soil (ASTM D-1587).
- Performing laboratory tests on selected representative soil samples to develop the engineering properties of the soil. These tests may include: pocket penetrometers, unconfined compression, present moisture content, percent passing 200 sieves, dry densities, Atterberg Limits, and swell tests, as deemed appropriate.
- Utilizing the results of observations both in the field and in limited laboratory tests, Earth Engineering will author a report that will include the following subjects:

- soil stratigraphy: soil encountered up to 40 feet
- groundwater conditions and groundwater control during construction
- boring log information will include all laboratory test results and field observations
- recommend suitable foundation design options for the building
- recommend slab on-grade design criteria, including the need for sub-grade replacement with fill or lime stabilization of the sub-grade
- calculate the soil heave using the potential vertical rise (PVR) method
- recommend whether structural slabs are required in lieu of slab on-grade
- specify sub-grade compaction requirements for slab on-grade and pavement structure
- present plates necessary to calculate uplift capacity and lateral capacity of drilled and underreamed piers, if necessary
- provide pavement recommendation including rigid and fixable pavement
- provide recommendations on subgrade stabilization
- recommend construction considerations, as deemed necessary
- recommend back-fill material specifications

- Incorporating all of the above into a geotechnical engineering report which is performed under the direction of, and signed by, a professional engineer registered in the State of Texas.

3.0 SUBSURFACE EXPLORATION

3.1 Sampling Techniques

The subsurface conditions were explored by a total of eight (8) borings. The borings were drilled by a truck-mounted drill rig. The boring locations are shown on Plate 2.

Samples in cohesive and semi-cohesive soils (clays, sandy clays, and silty clays) were obtained using a three-inch diameter Shelby Tube sampler advanced hydraulically by one stroke in accordance with the procedures outlined in ASTM D-1587. Samples were extruded in the field, visually classified, and a strength

estimate was obtained with a pocket penetrometer. Penetrometer readings are tabulated on the logs of borings. Representative portions of the samples were wrapped with aluminum foil and sealed for transport to the laboratory for further testing.

3.2 Sample Disposal

In general, soil samples (both tested and untested) will be discarded 30 days after the submittal of the final report, unless otherwise notified by the client.

4.0 LABORATORY TESTING

The laboratory-testing program was designed and directed towards evaluating the physical and engineering properties of the subsoils. Physical properties include Atterberg limits (liquid limits and plastic limits), moisture content for clays, and percent passing #200 sieve for sands. Engineering properties include shear strength of the soil, compressibility of the soils, and the swell characteristics of the soils. It should be noted that the testing program varies for each project and depends solely on the project budget and emphasis. Typically, Earth Engineering, Inc. specifies the anticipated testing program in each proposal. The tests undertaken in this program included the following:

Laboratory Tests	Applicable Test Standards	Number of Tests
Liquid Limit, Plastic Limit, and Plasticity Index of Soil	ASTM D-4318 Method B	18
Moisture Content	ASTM D-2216	29
Unconfined Compression Test	ASTM D-2166	7

Laboratory test results are presented in the Logs of Borings, Plates 3 through 10. A Key to Log Terms and Symbols is presented in Plate 11. It should be noted that the soils were classified in accordance with the Unified Soil Classification System (ASTM D-2487).

5.0 SUBSURFACE STRATIGRAPHY

5.1 Site Location and Conditions

The project site is located at Mowat Drive in Dickenson, Texas. Please refer to Plate 1 for maps designating the location of the site.

At the time of our geotechnical exploration. Several exiting buildings and parking were observed at the east side of the site. The west side was vacant and partially wooded.

Based on our visual observations during drilling operations, it appears that the site and the surrounding area exhibit topographic variations of about four (4) feet.

5.2 Subsurface Conditions

The subsurface conditions at the project site were evaluated based on eight (8) soil borings. Soil stratigraphy details are presented on the Log of Borings, Plates 3 through 10. The soil strata listed below are general in nature and highlight major subsurface soils. The boring logs include a summary of soil properties at certain depths.

The stratifications shown on each boring log represent the conditions and approximate boundaries between strata at that actual boring location only. The actual transitions between strata may be gradual. Variations will occur and should be expected at locations away from each boring location.

Based on field logs and laboratory test results, the approximate subsoil stratigraphy is presented in following tables:

Buildings areas (B-4 through B-8)

Stratum No.	Range* of Depth, ft.	Soil Description and Classification (Based on Unified Soil Classification System)
I	**0-30** at **B-4, B-5** and **B-6** **0-40** at **B-7** and **B-8**	**FAT CLAY (CH),** firm to very stiff, dark gray to brownish gray with ferrous stains, calcareous nodules and roots fibers at the upper layer. **"Pavement layer with a thickness ranging from 9 to 11 inches were encountered at B-4 and B-5 location"**

*These stratum depths are based on measurements referenced from ground surface at the time of our drilling activities on October 15-16, 2019. Please note that the depths of the stratum changes vary; please refer to the boring log presented on Plates 6 through 10 for stratum changes at specific locations.

Stratum (I) consists of firm to very stiff dark gray to brownish gray fat clays. These soils are highly plastic with plasticity indices ranging from 33 to 54. These soils are expected experience **significant** volumetric changes if form of shrink and swell due to changes in seasonal moisture content.

Parking areas (B-1 through B-3)

Stratum No.	Range* of Depth, ft.	Soil Description and Classification (Based on Unified Soil Classification System)
I	**0-5** at **B-1, B-2 and B-3**	**FAT CLAY (CH) / SANDY LEAN CLAY,** soft to very stiff, dark gray to brownish gray with ferrous stains, calcareous nodules, shells and roots fibers at the upper layer. **"Pavement layer with a thickness ranging from 2 to 11 inches were encountered at B-1 and B-2 location"**

*These stratum depths are based on measurements referenced from ground surface at the time of our drilling activities on October 15-16, 2019. Please note that the depths of the stratum changes vary; please refer to the boring log presented on Plates 3 through 5 for stratum changes at specific locations.

Stratum (I) consists of soft to very stiff dark gray to brownish gray fat clays. These soils are highly plastic with plasticity indices ranging from 14 to 52. These soils are expected experience **significant** volumetric changes if form of shrink and swell due to changes in seasonal moisture content.

5.3 Groundwater Conditions

The borings were drilled using a flight auger (dry method) to better assess the groundwater conditions.

Short-term groundwater was not encountered drilling operations however long-term groundwater measurements show an increase in groundwater level. The following table presents the ground water table measurements findings:

Boring Number	5 mins	10 mins	15 mins	10 hours	24 hours
B-1	Dry	Dry	Dry	Dry	Dry
B-2	Dry	Dry	Dry	Dry	Dry
B-3	Dry	Dry	Dry	Dry	Dry
B-4	Dry	Dry	Dry	Dry	4' 9"
B-5	Dry	Dry	Dry	Dry	5' 11"
B-6	Dry	Dry	Dry	28' 1"	9' 11" (cave-in depth)*
B-7	Dry	Dry	Dry	Dry	Dry
B-8	Dry	Dry	Dry	30" 4"	7' 1" (cave-in depth)*

*The long-term groundwater measurement at B-6 and B-8 assumed as the cave-in depth.

Groundwater fluctuations in an area can be caused by several factors including seasonal rainfall quantity in the area, the presence of wells near the site, the relative location (upstream or downstream) and proximity of the site to any bayous or streams.

Accurate groundwater measurements can be measured only using piezometers or monitor wells. Piezometer installation was beyond the scope of this project.

The groundwater level should be verified before drilled piers excavation and the commencement of utility construction.

6.0 ANALYSIS AND RECOMMENDATIONS

6.1 General

In order to assure a satisfactory foundation performance, foundations should be designed to fulfill the following requirements:

- The imposed structural loads should not exceed the allowable bearing capacity
- The potential total settlement and differential settlement are within tolerable limits of the structure, and
- The potential soil heave is within tolerable limits of the structure.

Foundation design recommendations are presented in the following paragraphs.

6.2 Foundation Types and Associated Risks

Construction of lightly loaded structures is challenging for engineers, architects, developers, and builders. It is our experience that economic considerations usually govern the choice of foundation systems and the associated risks. There are associated risks with all of the foundation systems. However, in general, risks decrease as the cost of the foundation system increases. A list of the most common foundation systems that are used in the Houston and Gulf Coast area for residential projects is shown below. *These foundation systems can be used to support the proposed structure. It should be noted that the first option is the least risky while the drilled piers with a slab on grade is more risky.*

(1) Drilled Piers with a Structural Slab: This type of foundation consists of drilled and under-reamed piers (bell-bottoms) with a structural (self-supporting) slab. A minimum crawl space of six (6) inches should be used beneath the slab. This foundation system is considered the least risky because the slab is isolated from the on-site soils. The use of structural fill is not necessary if a structural slab is selected.

(2) Drilled Piers with a Slab-on-Grade: This type of foundation consists of drilled and under-reamed piers (bell-bottoms) with a slab-on-grade floor system. In our experience, we have found that properly designed and constructed drilled piers incorporating a slab on-fill floor system function very well in the Houston area, provided certain techniques are implemented. These techniques include maintaining positive drainage (drainage away from the foundation) around the structure and controlling vegetation and tree growth near the structure. Both of these techniques need to be utilized throughout the life of the structure. The Owner, the Architect, the Structural Engineer, the Project Manager, and the Civil Engineer should note with full knowledge that the slab-on-fill floor system may experience differential movements during its life due to changing environmental conditions at the site, including but not limited to altered drainage patterns, sewer leakages, and the addition or removal of trees and shrubs.

6.3 Drilled Straight Shafts and Drilled and Under-Reamed Piers

6.3.1 Allowable Bearing Capacity

Based on the subsurface conditions, Drilled Straight Shafts with structural slab is the best foundation systems to be utilized to support the proposed building. Groundwater was encountered during drilling operations. Foundation recommendations are presented as follows:

Foundation Type	Foundation Depth Below Existing Grade (feet)	Allowable Bearing Capacity (psf) Dead Plus Sustained Live Load Factor of Safety = 3	Allowable Bearing Capacity (psf) Maximum Net Load Factor of Safety = 2
Drilled and Underreamed Piers(2)(3)	15	3,000	4,500

Note:

1. Ground water was not encountered during drilling operations on 10/15-16/2019.
2. We highly recommend drilling at least five (5) test piers before installation of production piers to verify the soil stratigraphy and current ground water table.
3. **Due to the presence of the highly expansive fat clays throughout the borings depths, the piers were extended to a depth of 15 feet.**
4. The drilled and under-reamed piers should be founded at least two (2) bell diameters measured center to center.

5. No existing surveying map or proposed final grading plan has been provided to Earth Engineering for the proposed building.

6. The foundation recommendations are based on our assumption that the finished floor elevation for the proposed building will be at or near (within 1 to 2 feet of) the existing grade.

Drilled and underreamed piers should be designed to resist both axial and uplift loads. Uplift pressures are applied at the perimeter of the shaft. It is recommended to design the piers to resist uplift adhesion stresses of 1,500 psf along the upper eight-(8) feet of the shaft length.

Since the uplift stresses are applied at the shaft, it is recommended to limit the bell to shaft ratio to 3:1, thus reducing the area upon which the uplift stresses act. However, in the event that bell caving occurs during construction, a bell to shaft ratio of 2:1 should be constructed.

Soil stratigraphy and groundwater level may vary within the proposed construction site. Therefore, it is recommended to install four (4) corner piers and one (1) center pier first to verify the groundwater level and soil stratigraphy. The depths of the remaining piers may be adjusted accordingly.

6.3.2 Uplift Pressures from Expansive Soils

As mentioned earlier, drilled shafts/piers should be designed to resist both axial and uplift loads. Uplift pressures are applied at the perimeter of the shaft above the pier's bell. It is recommended to design the piers to resist uplift adhesion stresses of 1500 psf along the upper eight (8) feet of the shaft length above the bell. We recommend that each shaft/pier be sufficiently reinforced throughout the full length of the shaft to prevent any cracks that may result from the tensile stresses induced by the expansive soils.

Uplift forces due to expansive soils can be estimated using the following equation:

$$Q_{uf} = 3.142 * Z_a * B_s * f_a \quad \text{.....(1)}$$

where:

Q_{uf}	=	Uplift force due to swelling pressure, kips
Z_a	=	Depth of Active Zone, feet = 8 feet
Z_a	=	Depth of Active Zone, feet = 3 feet for paved areas and areas covered with slab
B_s	=	Shaft diameter, feet
f_a	=	Uplift adhesion stress, ksf = 1.5 ksf

6.3.3 Uplift Capacity of Drilled and Underreamed Piers

The uplift capacity of a single drilled and underreamed pier in clay can be estimated using the following equation:

$$Q_{u\,max} = [N_u * C + \gamma * D_b]* A_u + 0.5\, W_{DL}$$

Where:

Q_u	=	Maximum uplift capacity in kips
C	=	Average Shear Strength, kips per square foot (ksf) = 1.5 ksf (Safety Factor =2.0)
N_u	=	Bearing Capacity Factor for Uplift = 3.5 D_b / B_b
D_b	=	L-Z_a, feet
L	=	Length of Pier, feet
Z_a	=	Depth of Active Zone, feet = 8 feet; Z_a = 3 feet for paved areas and in slab areas.
B_b	=	Pier bell diameter, feet
B_s	=	Shaft Diameter, feet
γ	=	Design unit weight of soils = 120 pcf
A_u	=	.785 (B_b^2-B_s^2), square feet
W_{DL}	=	Dead Load on Column, kips

The above equation can be used to calculate uplift capacity of short and rigid underreamed piers to resist external (such as wind etc.) as well as internal (due to soil's swelling pressures) uplift forces.

6.4 Potential Floor Slabs Associated with Drilled Shaft/Piers

6.4.1 Structural Slab

Based on the existing soil conditions, a structural floor system with a **6-inch** void/crawl space is the most suitable for the structure.

Foundation recommendations and associated risks were discussed in previous paragraphs. ***The structural slab usually entails the least risk because it is isolated from the on-site soils***. If a structural (suspended) floor system is selected.

6.4.2 Slab on-Grade

Although the use of a structural slab is strongly recommended due to the isolation of the slab from the existing soils at the site, a foundation system incorporating drilled piers or straight shafts with a slab on-grade can be used for this project. Foundation recommendations and associated risks were discussed in previous paragraphs.

The structural slab usually entails the least risk because it is isolated from the on-site soils. However, we understand the cost of such a system is usually cost prohibitive if the area of the slab is large.

Slabs supported on compacted fill have been successfully used in the Houston and Gulf Coast area. This option is usually economically feasible and can be effective if used with positive drainage and vegetation and tree control. Positive drainage entails directing the rainwater away from the structure and not allowing the water to pond or collect near the structure throughout its life.

The potential of a soil to heave is critical in determining the amount of fill necessary for a slab on-fill system. The potential soil heave was estimated using the Potential Vertical Rise (PVR) method. The PVR method was a result of extensive research by the Texas Department of Highways and Public Transportation in 1971 and 1972. Based on this method (TDHPT Method TEX-124-E), PVR was estimated with different fill thickness.

A graph showing the potential heave for the amount of fill added above grade is presented below. The points on the y-axis show the amount of heave that the soil would experience if no structural fill were to be added above the existing grade. The graph displays results for the following soil conditions:

- Existing moisture in the field during the time of drilling on 10/15-16/2019
- Wet moisture conditions (lower bound) during prolonged rainy season
- Dry moisture conditions (upper bound envelope) during prolonged drought

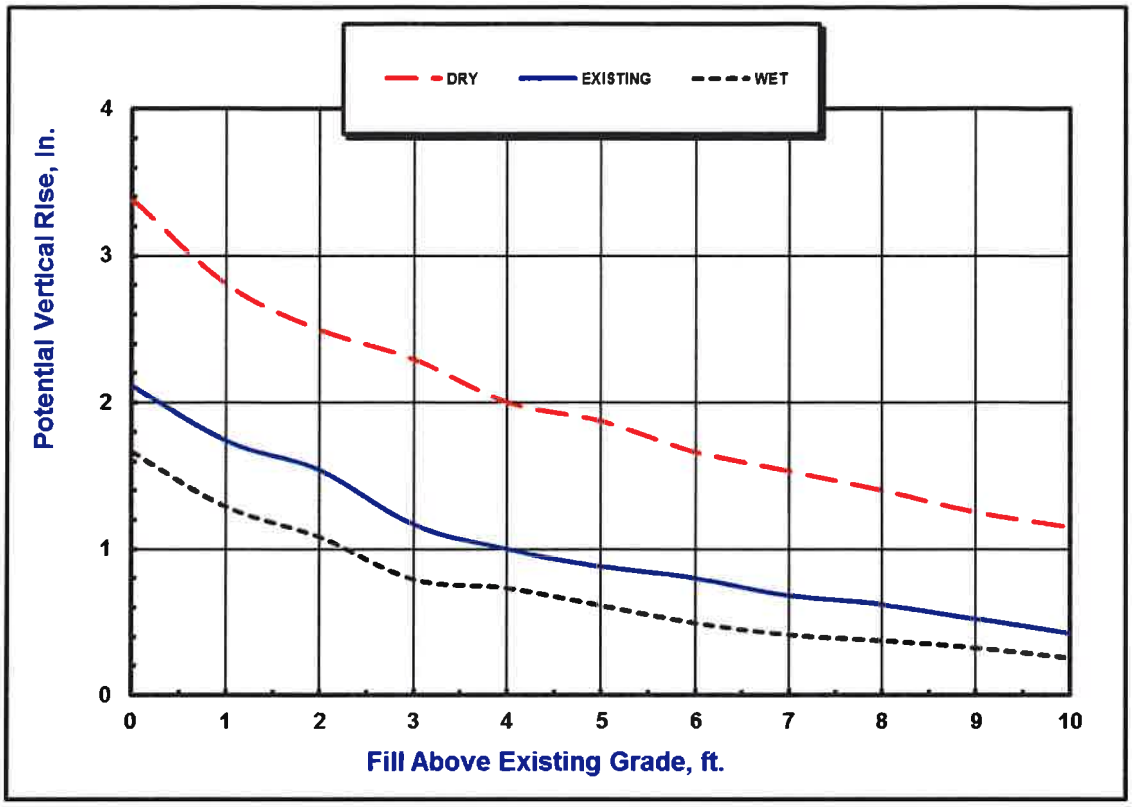
In order to quantify the risk involved due to expansive soils, Earth Engineering developed a unique in-house program called "**PVR CALC**". The program is written in Visual Basic code for Windows and uses the TEX-124-E method to compute the Potential Vertical Rise (PVR). The table below shows the input data for the PVR analysis.

Depth, feet	Average LL, %	Average PL, %	Average PI, %	Existing W,%	Moisture Condition
0-2	61	21	40	33	WET
2-4	64	21	43	28	AVG
4-6	75	23	52	34	WET
6-8	67	21	46	29	AVG
8-10	67	21	46	24	DRY

LL: Liquid Limit, PL: Plastic Limit, PI: Plastic Index, W: Moisture Content

The graph below shows the results of the PVR analysis for the soil conditions displayed in the table above. The graph shows the relationship between the amount of fill added above grade and the corresponding value for the PVR. As the amount of structural fill added above grade is increased, the PVR decreases.

The points directly on the y-axis show the amount of heave that the on-site soils would experience if no structural fill were to be added above the existing grade.



Note:

1. Potential Vertical Rise (PVR) is a function of the Plasticity Index (PI) and the moisture content of the soils. While plasticity index of the soil is constant, the moisture content varies depending on seasonal rainfall quantity, presence of trees in the vicinity as well as site drainage.

The general acceptable practice in Houston and the surrounding area is to limit the PVR to one inch or less. The amount of fill required to limit the PVR to one inch can lower the risk of heave to an acceptable level. The one (1) inch tolerable (design) heave is a serviceability index only

Foundation movements resulting from potential vertical rise (PVR) of one (1) inch or less do not account for the movement criteria required by the owner or occupants of the facility. The operational performance criteria may often be more restrictive than the structural criteria of one (1) inch of PVR. If a more stringent criterion is required of less than one (1) inch of PVR; Earth Engineering should be contacted to revise the recommendations to fit the new movement criteria.

In past projects, the author of this report has observed cracks in slabs that were caused by a heave of about one-fourth (1/4) inch. However, a combination of a sound structural design coupled with sound construction methods, proper drainage, and proper maintenance will reduce the possibility of heave.

Either the existing or dry condition curve can be used to estimate the amount of heave. The PVR for the site is estimated to be **3.40 inches** for dry moisture conditions and **2.15 inches** for existing moisture conditions respectively. Remedial action will need to be taken to reduce the PVR to an acceptable level as the estimated PVR is greater than one (1) inch.

Based on above chart more than ten (10) feet of select fill need to be added above existing grade to reduce the potential vertical rise (PVR) to permissible limit of 1-inch. Despite being an economical option, adding select fill is not a practical option for this particular project.

If drilled and under-reamed piers with slab on grade foundation system is selected, we highly recommend one of the following options. **(If these options are not feasible, use structural slab with at least 6-inch void boxes.)**

1. Excavate and remove at least six (6) feet of expansive soils, lime stabilize the subgrade soil from six (6) feet to seven (7) feet with 7% lime (70 lbs per square yard per 12 inches of depth), and backfill with select structural fill compacted in 8-inches lift to 95% of the maximum proctor density.

2. Excavate seven feet of the existing expansive soil, stockpile on site then mix with 7% lime (70 lbs per square yard per 12 inches of depth). Backfill the mixed soil in 8-inches compacted lifts to 95% of the maximum proctor density within a ± 3 percent of the optimum moisture content. The plasticity indices (PI's) of the mixed soil should ranging between 12 and 20.

3. Depending upon finish floor elevation, a combination of partial undercut, backfill and subgrade lime-stabilized can be utilized. In such circumstances, we recommend to have at least six (6)-feet of cushion of select fill (below the slab) placed on the top of at least 12-inches of lime stabilized subgrade soils to limit the potential vertical rise to permissible limit of 1-inch.

4. If option 1 & 2 are not practical, use structural slab with 6-inch void boxes.

Do not extend the fill outside of the building areas in order to prevent infiltration of rainwater into the fill soils. Rainwater infiltration through the fill soils will create bath-tub effects (perched water conditions) under the slab. In addition, it is highly recommended to lime stabilize the upper twelve (12) inches around the building and extend it horizontally five (5) feet beyond the perimeter of the building.

The fill soils placed on the site should consist of low plasticity sandy clays with plasticity indices (PI's) ranging between 12 and 20. Sands, or silts, are not considered fill and, therefore, should not be used in lieu of sandy clays. The fill soils should be placed in loose eight (8) inch lifts and compacted to 95% of the maximum density as determined by ASTM D-698. The moisture contents of the structural fill should be within a ± 3 percent of the optimum moisture content.

The floor slab should be installed as soon the structure pad is prepared. The slab should be protected from inclement weather at all times by providing proper drainage and placing plastic sheeting on top of the slab.

If the structure pad is left exposed to rainfall, perched groundwater conditions may develop which will undermine the integrity of the floor slab. Therefore, the floor pad should be covered with a plastic sheet, if the floor slab is not placed immediately.

In the event that the floor slab is not installed after structural slab is prepared, the in situ slab densities must be retested at several locations within the slab areas prior to slab placement. All densities must be at least 95% of the maximum dry density and the optimum moisture contents should be with ±3% of the optimum moisture content.

If the densities fail, then the deeper layers must also be retested. All the failed areas must be excavated, aerated or chemically stabilized, than placed in eight (8) inch loose lift and re-compacted to 95% of maximum dry density and within ±3 of optimum moisture content.

All trenches (sanitary, water, cable, electrical) should be properly backfilled and compacted to 95% of the maximum dry densities. Sand or other permeable materials should not be used as backfill. Improperly backfilled and improperly compacted trenches, if left exposed, can also lead to the development of perched groundwater conditions.

In general, perched water tends to be trapped within the fill. The trapped groundwater tends to soften the subgrade. The excess moisture promotes clay expansion (heave) which may be a detriment to the integrity of the slab foundation and structure. Positive drainage should be maintained across the entire structure pad.

Clay plugs must be utilized at the entrance and exit of all pipes under the building area to prevent water intrusion into the slab bedding soils. Plumbing leak tests should be performed periodically to detect any leaks within the system.

6.5 Grade Beams Associated with Drilled Piers

We recommend extending both the exterior grade beams to a depth of 30 inches below the final grade at the site. A system of grade beams may be incorporated in the design of the slab in order to increase the slab stiffness. Stiffened slabs are usually less prone to cracking. The number and the dimension of the grade beams are left to the discretion of the structural engineer.

The project team (Architect, Structural Engineer, Project Manager, Contractor and the Owner) must recognize that poor drainage, plumbing leakages, sanitary

sewer leakages, and sprinkler systems around the structure are potential sources of moisture that could easily migrate under the exterior grade beams into the slab area. This type of excess moisture promotes clay expansion (heave), which may be detrimental to the integrity of the slab, foundation, and structure.

6.7 Flatwork

Flatwork (such as sidewalks, ramps etc.) outside the building area will be sensitive to movement; therefore, subgrade preparations should be implemented in a similar fashion as for slab area. Proper preparation of the flatwork subgrade will help in minimizing differential movements between the building and the flatwork adjacent to the building.

If the flatwork subgrade is not installed in a manner similar to the building slab, these areas will be susceptible to post-construction movements (larger PVR values), which may then result in reversed drainage patterns that direct run-off towards the structure(s).

6.8 Lifetime Maintenance and Construction Considerations

6.8.1 Site Drainage

The site should be graded in such a manner as to channel all rainwater away from the structure. Water should not be allowed to pond around the structure. Positive site drainage will reduce the exposure of the on-site clays to moisture, thus eliminating potential swelling of the on-site clays.

The exposed, unpaved ground should be sloped away from the structure at a minimum grade of 5% and should extend at least 10 feet beyond the perimeter of the building upon completion of construction and landscaping. We recommend verifying the final grades to ensure that effective drainage has been achieved

The grading around the structure should be periodically inspected and adjusted as necessary, as part of the maintenance program. Positive site drainage should be maintained throughout the lifespan of the structure.

6.8.2 Plumbing

Due to the presence of silty sands and silty sandy clays soils, installing a watertight plumbing system is critical. Water leakage due to poor plumbing will have detrimental effects on the performance of the structure and foundation. Plumbing leakage tests should be performed periodically to detect any leaks within the system before irreversible damage to the foundation is caused.

6.8.3 Roof Gutters and Downspouts

Roof gutters should be utilized to direct roof runoff away from the structure. Downspouts should not be allowed to discharge near the structure. Downspout extensions should be used to facilitate rapid rainwater discharge away from the structure. Ideally, the downspouts should be directly connected to the storm sewer system.

6.8.4 Presence of Trees near the Structure

Trees should be planted a distance away from the structure equivalent to the anticipated height of the mature tree. Tree roots are continually growing and seeking new moisture sources. Trees are capable of withdrawing large quantities of water from the soil, which causes a net volume reduction in the soil matrix. The decrease in water volume within the soil matric can result in excessive settlement. Additionally, if existing trees are removed from an area, heave may occur due to the reallocation of moisture within the soil matrix. This process is known as moisture equilibration and may take as long as ten (10) years.

In general, the drying effects of a tree impact a circular area radiating outwards from the base of the tree with a radius roughly equal to the height of the mature tree. Thus, all trees should be a planted away from the structure at a minimum distance that is equal to the maximum anticipated tree height. If trees are planted in close proximity to the structure, the roots will extend below the slab areas and cause distress to the slabs. Root barriers should be constructed around the perimeter of the building in the event that trees are located a distance away from the structure that is less than the maximum anticipated height of the mature tree. Root barriers should extend at least seven (7) feet below grade.

6.8.5 Landscaping

Landscaping and irrigation should be minimized as much as possible around the structure. Plants located within 10 feet of the structure should be self-contained to prevent water from infiltrating into the subgrade soils located beneath the building and pavement. The sprinkler mains and spray heads should be installed at a minimum distance of 7-10 feet away from the building lines. Low volume, drip-style irrigation systems should not be used in the vicinity of the building.

6.8.6 Structural Design Considerations

The floor slabs should be provided with a moisture barrier to prevent migration of the capillary moisture through the slab. Fifteen (15)-mill Visqueen can be used.

7.0 PAVEMENT RECOMMENDATIONS

7.1 General

The following recommendations are based on sub-soil exploration borings drilled at the building area. Earth Engineering highly recommends verifying the following recommendations with actual in-field condition at the parking area before construction.

Fat clay soils with high plasticity were encountered at all borings.

Selecting the proper pavement system for the soil conditions at the site is also essential. In general, a flexible (asphalt) pavement system is more tolerable to differential settlements as compared to a rigid (concrete) system. Pavement design recommendations will be presented for both asphalt and concrete pavements.

7.2 Anticipated Traffic

Traffic counts were not available during this study. However, it is anticipated that the driveways and parking area pavement will be exposed to light traffic that consists mainly of passenger cars, delivery vehicles, and garbage trucks.

TRAFFIC DESIGNATION	DESCRIPTION
Light Traffic	Few vehicles heavier than passenger cars, no regular use by heavily loaded two axle trucks or larger vehicles.
Medium Traffic	Similar to light traffic with a maximum of 50 fully loaded two axle trucks per day. No regular use by three axles heavily loaded trucks.
Heavy	Similar to medium traffic with a maximum of 300 heavily loaded two axle trucks or buses and a maximum of 30 heavily loaded trucks with more than three axles per day.

Note that the above assumptions are valid mostly for parking lots and low to medium density streets. These assumptions are not valid for major arterial thoroughfare streets.

Recommendations are presented in the following sections.

7.3 Rigid Pavement

In general, flexible (asphalt) pavement systems are more tolerable to differential settlements as compared to rigid concrete systems. Pavement design recommendations will be presented for both asphalt and concrete pavements.

7.3.1 Pavement Thickness

Pavement design thickness is dependent on several factors. The factors include traffic loading, design reliability, concrete modulus of rupture, load transfer coefficients, effective modulus of subgrade reaction, and drainage provisions. Tabulated below are the assumed traffic frequencies and loads used to design pavement sections of this project:

CONCRETE PAVEMENT			
	Pavement Thickness (inches)		
Pavement Component	Low Traffic (Parking Area)	Medium Traffic (Driveways)	Heavy Traffic (Driveways)
Reinforced Concrete	5.0	6.0	7.0
Stabilized Subgrade	6.0	8.0	8.0

7.3.2 Subgrade Stabilization

The pavement area should be prepared in accordance with the site preparation recommendations presented in this report.

Since cohesive soils were encountered in surface, we recommend that the subgrade be stabilized with lime after the site and subgrade are prepared in accordance to our Site Preparation guidelines, the upper six inches (6") of the subgrade in the light traffic area and eight inches (8") in the medium and heavy traffic area should be stabilized with **eight (8%) lime** by dry weight in accordance with TxDOT Specification Item 260. This translates to about **45** pounds of dry lime per square yds for six (6) inches of stabilization depth, and is about **50**pounds per square yds for eight (8) inches of stabilization.

The amount of lime should be determined in the field after the site is stripped of top loose soil and the subgrade soils are exposed. The lime used should be (Type A) hydrated lime or (Type B) commercial slurry conforming to TxDOT Item 264. The subgrade should be compacted to 95% of the Standard Moisture Density Relationship (ASTM D-698) as specified in the Site Preparation Section of this report.

It is recommended to extend the pavement stabilization five feet beyond the perimeter of the pavement in order to preclude edge failure. It is also highly recommended to maintain positive drainage away from the pavement throughout the life of the pavement.

7.3.3 Temperature Steel Reinforcement and Joint Spacing

For concrete pavements that are placed on clay or sandy soils, it is typical to use #4 bars at 18 inches center to center both ways. A ¾ inch dowel, 18 inches in length spaced at 12 inches on centers at each joint can also be utilized.

Maximum control joint spacing of 12 feet is desirable throughout the pavement. If sawcut, control joints should be cut within 12 to 24 hours of concrete placements. However, proper reinforcement, joint spacing, and other pertinent design parameters should conform to ACI or AASHTO methods or standard local practices.

7.3.4 Concrete Curing

Unlike flexible pavement, concrete pavement should be cured at least 7-days after placing of concrete to preserve much needed moisture for hydration of cement. Curing plays a great part for the strength and durability of the concrete pavement. Unless otherwise specified, the concrete should be cured in accordance with Harris county specification for bridge and roads or equivalent specifications as following.

- The concrete should be protected against pitting and washing from rain and should keep above 50^0 F
- Concrete should be protected from direct sunlight and kept moist at least 7-days from placement day.
- Proper covering should be maintained throughout the curing period and pavement should be protected from the traffic until the desired strength is achieved.
- If the pavement is cured by sealing materials or by liquid membrane, it should be in accordance with item no. 421 in Harris County specification for pavement or equivalent specification.

7.3.5 Concrete Strength

The materials and characteristics of reinforced concrete pavement should meet the requirements presented in ACI manual for concrete practice. Typically, the concrete mix should have minimum 28-days compressive strength of 3,500 psi.

7.4 Asphalt Pavement

7.4.1 Pavement Thickness

Asphalt pavement thickness is dependent on several factors. The factors include reliability, traffic loads, and the effective subgrade resilient modulus.

ASPHALT PAVEMENT			
	Pavement Thickness (in inches) Not Valid for Major Arterial Thoroughfares		
Pavement Component	Low Traffic (Parking Area)	Medium Traffic (Driveways)	Heavy Traffic (Driveways)
Asphalt Surface	2.0	2.5	3.0
Crushed Limestone Base	8.0	10.0	12.0
Stabilized Subgrade	6.0	8.0	8.0

7.4.2 Subgrade Stabilization

Please refer to section 7.3.2 for details.

7.4.3 Hot Mix Asphaltic Concrete Course

The asphalt surface should be mixed in a batch plant and laid hot (Fine Graded Surface Course) in accordance with TxDOT Item 340 Type D (Hot Mix Asphaltic Concrete Pavement) and specific criteria for the job mix design formula. The mix should be designed for a stability of at least 40 and should be compacted to 95 percent, of the maximum theoretical density as measured by ASTM D 2041. The compacted asphaltic surface should contain air voids between 5% and 9%. The asphalt cement content of total mixture weight should be within ± 0.3 percent asphalt cement from the specific mix.

7.4.4 Crushed Limestone Base

The base material should consist of crushed limestone in accordance with TxDOT item 247 Type A, Grade 1 requirements. The base should be compacted to 95% of the maximum dry density as determined by the modified moisture/density relationship (ASTM D 1557) within –2 to +3 percent of the optimum moisture content.

8.0 CONSTRUCTION CONSIDERATIONS

8.1 Site Preparation

- Soft soils should be removed until firm soil is reached. The soft soils can be aerated and placed back in eight-inch loose lifts and compacted to 95% as specified by ASTM D-698 and within a ± 3 percent of the optimum moisture content.

- Tree stumps, tree roots, and any existing structures and pavement should be removed from the site area. If the tree stumps and roots are left in place, settlement and termite infestation may occur. Once a root system is removed, a void is created in the subsoil. It is recommended to fill these voids with structural fill or cement-stabilized sand and compact to 95% as specified by ASTM D-698 and within a ± 3 percent of the optimum moisture content.

- Depending on the virgin site conditions, organic may found at depths ranging from 2 to 2.5 feet below the existing grades (need to verify in the field). All organic materials should be scarified and removed prior to subgrade preparation.

- **Any low-lying areas including ravines, ditches, swamps, etc. should be filled with structural fill and placed in eight-inch lifts**. Each lift should be compacted to 95% of the maximum dry density as specified by ASTM D-698.

- The exposed subgrade should be scarified to a minimum depth of six (6) inches in the driveway and slab areas. The subgrade should then be compacted to 95% of the maximum density as determined by the Standard Moisture Density Relationship (ASTM D-698).

- A sheep-foot roller should be utilized to compact the fill soils. A smooth-drum compactor should then be utilized to seal the compacted fill. In the event that the upper six-(6) inches cannot be compacted due to excessive moisture, we recommend that these soils be excavated and removed or chemically stabilized to provide a firm base for fill placement.

- Proof rolling should be performed using a heavy tired loaded truck or pneumatic rubber-tired equipment weighting about 20 to 25 tons.

- The fill soils placed below the structures should consist of low plasticity sandy clays with plasticity indices ranging between 12 and 20.

- Sands or silts are not considered fill and therefore, should not be used in lieu of sandy clays.

- The fill soils should be placed in loose eight-inch lifts and compacted to 95% of the maximum density as determined by ASTM D-698.

- The floor slab should be placed as soon as possible after the building pad is prepared. If the building pad is left exposed to rainfall, perched groundwater conditions may develop which will undermine the integrity of the floor slab. All trenches (sewer, water, cable, electrical) should be properly backfilled and compacted to 95% of the maximum dry densities.

- Sand or permeable materials should not be used as backfill. Improperly backfilled and improperly compacted trenches, if left exposed, can result in perched groundwater conditions at the site. Perched groundwater conditions are highly undesirable Perched water tends to get trapped within the fill which then leads to softening of the subgrade and undermines the stability of the foundation. Positive drainage should be maintained across the entire building pad.

- A qualified soil technician should monitor all earthwork operations. Field density tests should be conducted on each lift using a nuclear density gauge. The gauge should be calibrated every day.

- Prior to field density tests, a 50-pound sample from the subgrade soils should be obtained. A similar sample should be obtained from the fill soils. A Standard Moisture Density Relationship (ASTM D-698) should be performed on each sample in order to obtain optimum moisture content and a maximum dry density. The field density tests should be compared to these results every time the soils are tested in the field.

The above recommendations are applicable to slabs, driveways, pavements and any structures that are supported directly on-grade

8.2 Site Drainage

Site drainage should be established during the first phase of construction. Water should not be allowed to collect or pond on the construction site. The site should be graded in such a manner to shed all rainwater away from the structure and foundation. *Positive site drainage should be maintained throughout the life of the structure.*

8.3 Drilled Pier Excavations

The field exploration was conducted on October 15-16, 2019. Groundwater was not encountered during drilling operation. However, it should be noted that the groundwater level usually fluctuates with seasonal moisture conditions. **Therefore, it is possible that the groundwater level may rise upward several feet during the rainy season. It is highly recommended to perform five (5)**

test piers (one in the center and one at each corner) prior to construction to verify the following:

- **the most current groundwater conditions just before construction**
- **the stability of the under-ream and shaft**
- **verify the presence of sand layers or thick sand seams**

An experienced drilling contractor should perform drilled and under-reamed pier excavations. The piers should be checked for levelness in order to prevent eccentric loading conditions. The belling bucket should be checked before the commencement of drilling to assure the right bell size. It is of prime importance that the bells are clear of loose materials and soil cuttings. In order to prevent concrete segregation and bearing area disturbance, it is recommended to use a tremie to pour the concrete if the depth of the pier exceeds eight (8) feet.

Soil stratigraphy and groundwater level may vary within the proposed construction site. Therefore, it is recommended to install four (4) corner piers and one (1) center pier before construction begins to verify the groundwater level and soil stratigraphy. The depths of the other piers may be adjusted accordingly.

Piers should not be allowed to remain open for an extended period or overnight. If pier excavation and backfilling with concrete cannot be completed the same day, the pier should be backfilled with excavated soils and re-excavated when excavation and concrete placement can be completed on the same day.

8.4 Excavations

8.4.1 Shallow Excavations

In general, shallow excavations refer to excavations with depths not be exceeding 15 feet. These excavations are usually kept open for a relatively short period of time. This type of excavation is generally performed for spread footings and underground utilities. Depending on excavation geometry, depth of the excavation and duration of the excavation, shoring (excavation support) may or may not be required. In general, shoring may be required to provide excavation stability for footings placed at relatively deeper depths and for excavations kept open for a longer period of time. However, all such excavations should also conform to applicable OSHA regulations.

8.4.2 OSHA Requirements

Excavation or trenching operations should be performed in accordance with the Occupational Safety and Health Act (OSHA) requirements as detailed in 29 CFR

part 1926, subpart p, as amended, including rules published in accordance with the Federal Register, Volume 54, number 209, dated October 31, 1989 as a minimum. In addition, the provisions of the Legislature (H. B. No. 662 and H. B. No. 665) should be satisfied.

The OSHA system classifies soil and rock taking into consideration the following:

- in-situ soil properties (shear strength)
- the presence of fissures in the soil matrix
- the classification of the soil (sands, clay, rock)
- construction considerations, including vibrations from heavy traffic, shaft driving, or similar effects
- submerged soil and seepage

The OSHA system classifies the soils into three categories: A, B, and C. It should be noted that OSHA classification categories are valid for trenches with maximum depth of 20 feet. Maximum allowable slopes are presented below.

Maximum Allowable Slopes

OSHA Classification	Short-Term Slope[1] (H:V)	Long-Term Slope[2] (H:V)
A	½ : 1	¾ : 1
B	¾ : 1	1 : 1
C	1 ½ : 1	2 : 1

(1) 48 hours or less
(2) Up to 72 hours

Based on the above discussion, most of the soils encountered in this site can be classified as follows:

Soil Description	OSHA Classification
FAT CLAYS	A

8.4.3 Excavations Inspection

We recommend that our geotechnical engineer observe excavations immediately prior to placing concrete. He should compare the soils exposed with those encountered in the soil test borings and document results. Any significant differences should be brought to the representative of the owner along with appropriate recommendations.

The excavations should be performed with equipment capable of providing a relatively clean bearing area. We recommended that the excavations be made

with a smooth-mouth bucket to minimize the amount of loose material in the excavation bottom and the disturbance to the bearing area.
The bearing surface should be protected against disturbance and deterioration. Any bearing area not concreted within the day it is exposed should be covered with a thin seal slab.

9.0 DESIGN REVIEW

EARTH ENGINEERING, INC. should be given the opportunity to review the construction design documents prior to release for bid to assure that our recommendations are interpreted as intended in our report. If we are not given the opportunity to review the final documents, EARTH ENGINEERING, INC. will not be responsible for misinterpretations of our recommendations by other parties. The design review is not part of our scope of work and would be an additional charge.

10.0 LIMITATIONS

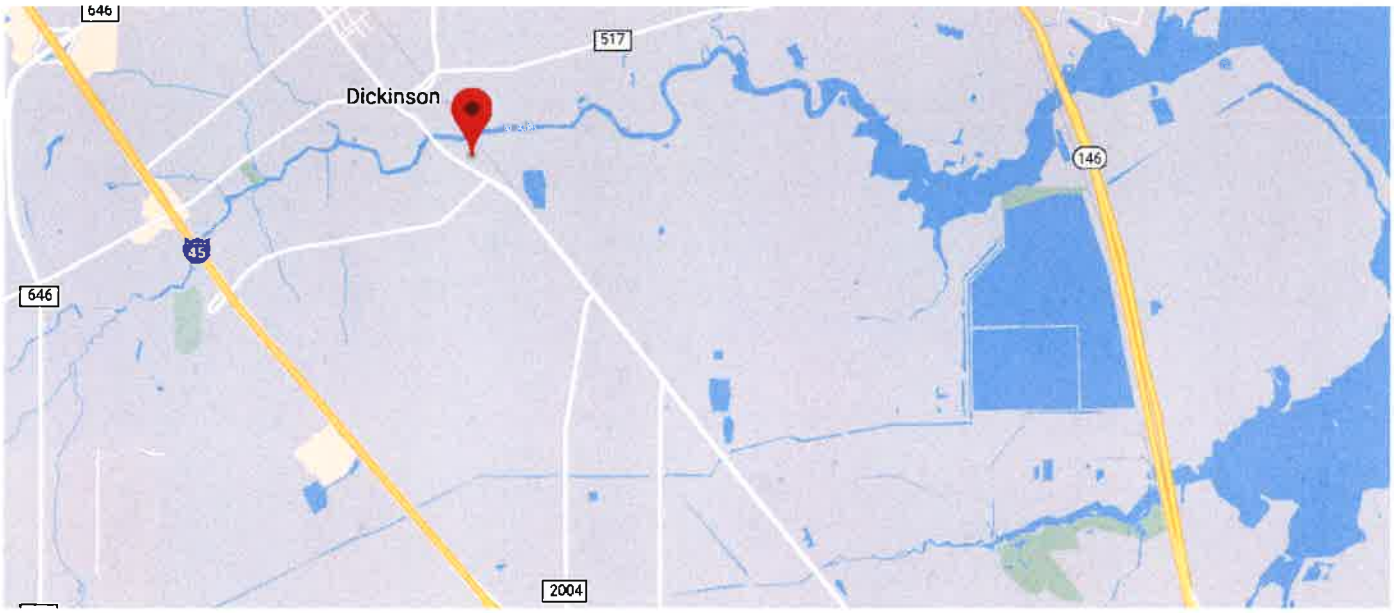
Our site exploration was based on eight (8) borings at select locations. Soil stratigraphy may change within the site. In the event that different soil conditions are encountered in the field, EARTH ENGINEERING, INC. should be immediately notified. It should be noted that fault study is not within the scope of work. This study was performed in accordance with generally accepted geotechnical engineering practices for design purposes only under the supervision of a licensed professional engineer in the State of Texas. Foundation recommendations presented herein are valid for one (1) year from the date of the report. After one (1) year, Earth Engineering, Inc. should be contacted to verify the validity of the recommendations prior to construction.

In the event that any changes in the nature, design, or location of the proposed building are made, the conclusions or recommendations presented in this report are not valid until the changes are reviewed by EARTH ENGINEERING, INC. and the conclusions and recommendations are modified in writing.

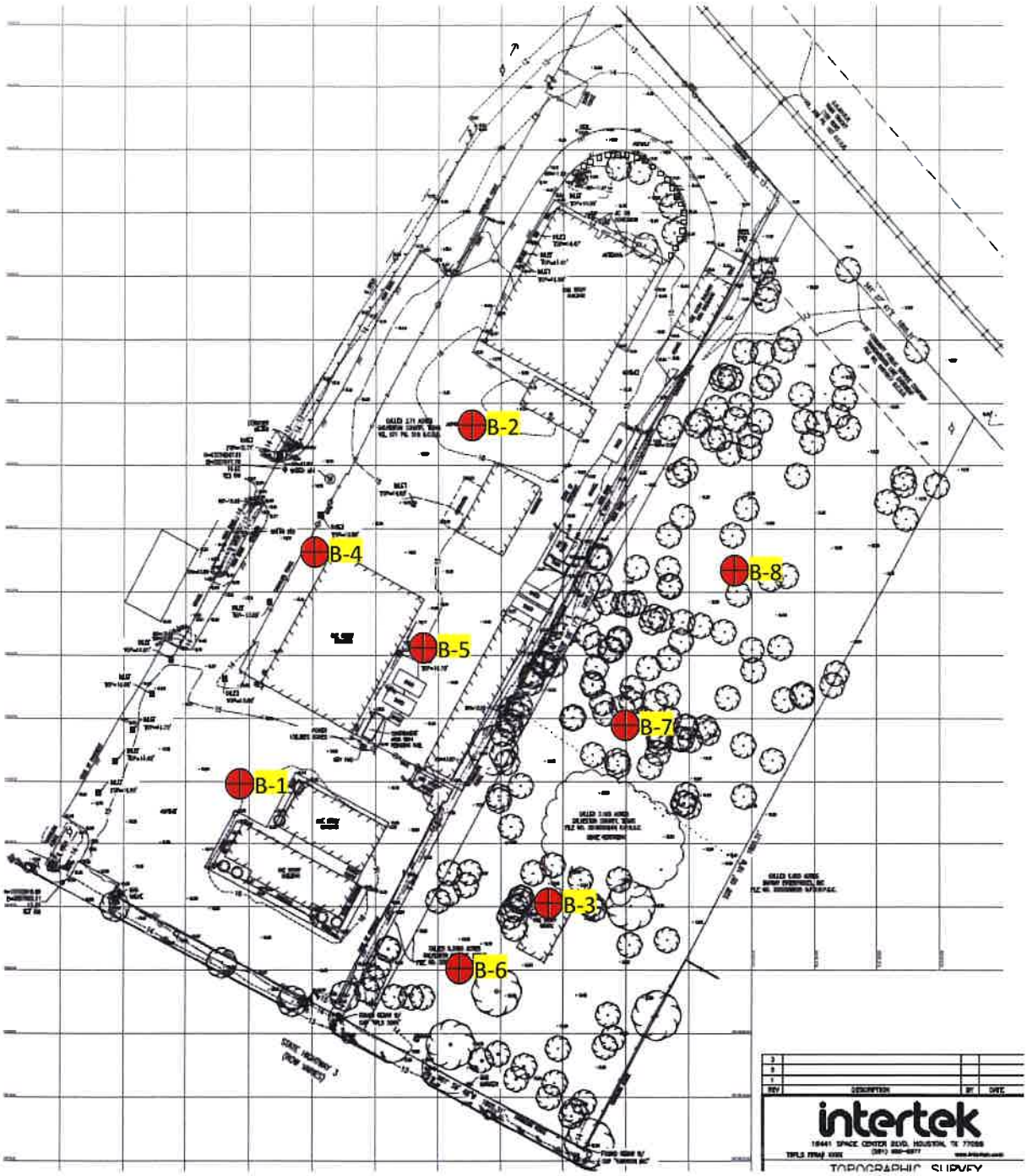
11.0 CONSTRUCTION MATERIALS TESTING

Quality control (QC) is extremely important in the construction industry. A quality control program should be initiated at the beginning of the project. The program should be designed by an accredited laboratory to cover all stages of construction from the ground up. EARTH ENGINEERING, INC. would be pleased to provide you with a proposal for these services:

- Soil Compaction (fill under-slab, utility backfill, etc.)
- Soil Stabilization (lime or lime/fly-ash)
- Foundation Inspection and Monitoring (drilled piers, drilled shafts, auger cast piles, spread footings, driven piles and spread footings)
- Concrete Inspection & Monitoring
- Rebar Inspection
- Structural Steel Welding Visual Inspection and Non-Destructive Testing
- Fire-Proofing Inspection
- Floor Flatness and Floor Levelness (FF/FL), using F-Numbers system.
- Maturity Probes and Thermocouplers to Measure Concrete Temperature and Strength.



SITE LOCATION	EARTH ENGINEERING INC Geotechnical, Environmental and Material Testing	
Proposed Galveston County Roads and Bridges Facility in Dickenson, TX.	Scale: N.T.S.	Date: 11/01/2019
	Project: EE-1919908-G	Plate 1



Plan of Borings (Site Plan)	EARTH ENGINEERING INC Geotechnical, Environmental and Material Testing	
Proposed Galveston County Roads and Bridges Facilities in Dickenson, TX.	Scale: N.T.S.	Date: 11/01/2019
	Project: EE-1919908-G	Plate: 2

LOG OF BORING: B-1

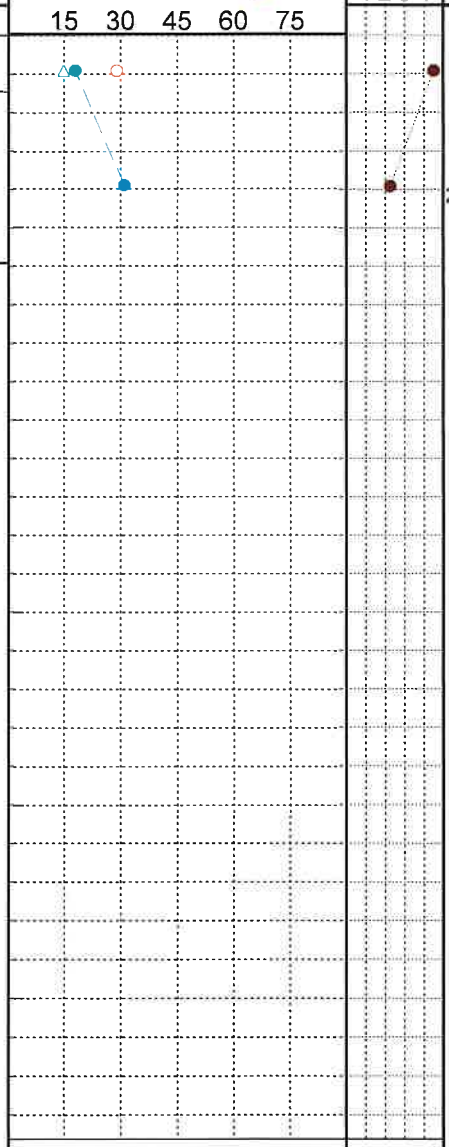
Project: Proposed Galveston County Road & Bridge Facility, Dickenson,TX
Client: Page, Inc.
Location: Galveston County Road & Bridge Facility
Driller: Van & Sons
Easting: **Northing:**

Project NO.: EE-1919908-G
Drilling Depth (ft): 5.91
Elevation (ft):
Logged By: Raul G.
Weather:

DEPTH (ft)	GRAPHIC LOG	SAMPLERS	Description Surface Elevation: Existing	USCS	PPEN (tsf)	SPT (Blows/ft)	M. Content (%)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	Cohesion (KSF)	Dry Density (PCF)	<#200 Sieve
0			3 inches Asphalt and 8 inches blackbase										
			SANDY LEAN CLAY, very stiff, dark gray, moist	CL	4.5		18	29	15	14			
2			--shells from 1-3 ft										
4			--stiff from 3-5 ft		2.25		31						
			Boring terminated at 5.91 feet.										

Test Result Curves

Plastic Limit △
Liquid Limit ○
Blow Counts ⊕
Moisture Content ●



This information pertains only to this boring location and should not be interpreted as being indicative of the whole site

WATER LEVEL MEASUREMENTS (ft.)

Initial: dry

After 15 mins: dry

DATE DRILLED: 10-15-2019

Plate: 9

EARTH ENGINEERING, INC.
4877 Langfield Rd. Houston, TX 77040

Geotechnical, Materials Testing & Environmental Consultants.
Phone:713-681-5311 Fax:713-681-5411 www.eartheng.com

LOG OF BORING: B-2

Project: Proposed Galveston County Road & Bridge Facility, Dickenson,TX
Client: Page, Inc.
Location: Galveston County Road & Bridge Facility
Driller: Van & Sons
Easting: **Northing:**

Project NO.: EE-1919908-G
Drilling Depth (ft): 5
Elevation (ft):
Logged By: Raul G.
Weather:

DEPTH (ft)	GRAPHIC LOG	SAMPLERS	Description Surface Elevation: Existing	USCS	PPEN (tsf)	SPT (Blows/ft)	M. Content (%)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	Cohesion (KSF)	Dry Density (PCF)	<#200 Sieve
0			2 inches Asphalt No Sample retrived										
2			FAT CLAY, soft, dark gray, moist --calcareous nodules from 2-3 ft --firm, light grayish dark gray from 3 5 ft	CH	0.75 1.25		32	61	21	40			
4			Boring terminated at 5 feet.										

Test Result Curves: Plastic Limit △, Liquid Limit ○, Blow Counts ◇, Moisture Content ●; 15 30 45 60 75

PPEN Curve: 1 2 3 4

This information pertains only to this boring location and should not be interpreted as being indicative of the whole site

EARTH engineering, inc.	**WATER LEVEL MEASUREMENTS (ft.)**	**DATE DRILLED:** 10-15-2019
	▽ **Initial:** dry ▼ **After 15 mins:** dry	**Plate:** 4

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4877 Langfield Rd. Houston, TX 77040
Geotechnical, Materials Testing & Environmental Consultants.
Phone:713-681-5311 Fax:713-681-5411 www.eartheng.com

LOG OF BORING: B-3

Project: Proposed Galveston County Road & Bridge Facility, Dickenson,TX
Client: Page, Inc.
Location: Galveston County Road & Bridge Facility
Driller: Van & Sons
Easting: **Northing:**

Project NO.: EE-1919908-G
Drilling Depth (ft): 5
Elevation (ft):
Logged By: Raul G.
Weather:

DEPTH (ft)	GRAPHIC LOG	SAMPLERS	Description Surface Elevation: Existing	USCS	Test Result Curves (Plastic Limit △, Liquid Limit ○, Blow Counts ⊕, Moisture Content ●; 15 30 45 60 75)	PPEN Curve (1 2 3 4)	PPEN (tsf)	SPT (Blows/ft)	M. Content (%)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	Cohesion (KSF)	Dry Density (PCF)	<#200 Sieve
0			FAT CLAY, firm, dark gray, moist --roots from 0-2 ft	CH			2.0		31	75	23	52			
2			--tannish gray from 2-5 ft --ferrous stains from 2-4 ft				1.0								
4							1.0		33						
			Boring terminated at 5 feet.												

This information pertains only to this boring location and should not be interpreted as being indicative of the whole site

EARTH engineering, inc.	**WATER LEVEL MEASUREMENTS (ft.)**	**DATE DRILLED:** 10-16-2019
	▽ **Initial:** dry ▼ **After 15 mins:** dry	**Plate:** 5

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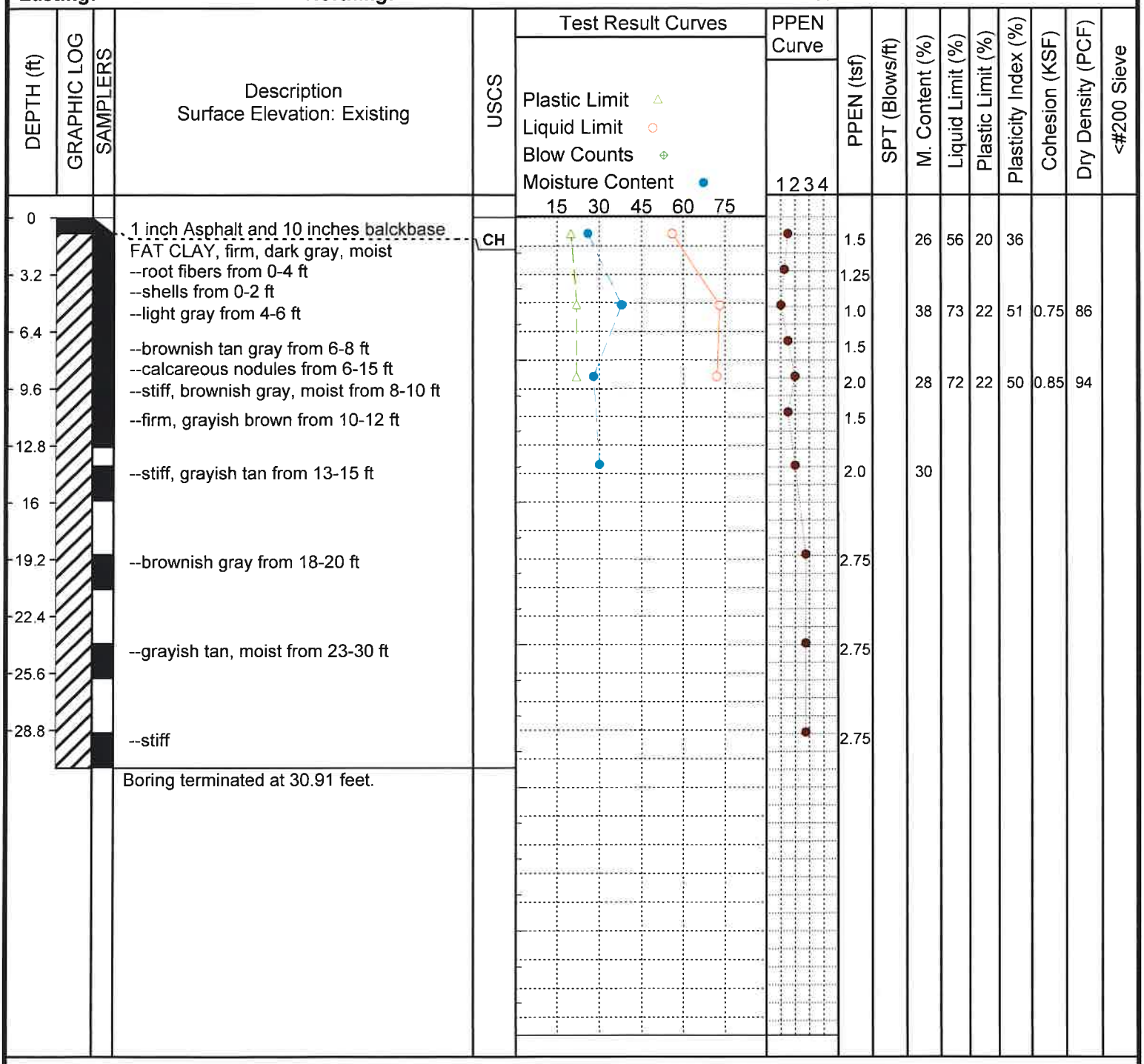
LOG OF BORING: B-4

Project: Proposed Galveston County Road & Bridge Facility, Dickenson,TX
Client: Page, Inc.
Location: Galveston County Road & Bridge Facility
Driller: Van & Sons
Easting: **Northing:**

Project NO.: EE-1919908-G
Drilling Depth (ft): 30.91
Elevation (ft):
Logged By: Raul G
Weather:



DEPTH (ft)	Description / Surface Elevation: Existing	USCS	PPEN (tsf)	SPT (Blows/ft)	M. Content (%)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	Cohesion (KSF)	Dry Density (PCF)	<#200 Sieve
0	1 inch Asphalt and 10 inches balckbase										
	FAT CLAY, firm, dark gray, moist	CH	1.5		26	56	20	36			
3.2	--root fibers from 0-4 ft		1.25								
	--shells from 0-2 ft										
	--light gray from 4-6 ft		1.0		38	73	22	51	0.75	86	
6.4	--brownish tan gray from 6-8 ft		1.5								
	--calcareous nodules from 6-15 ft										
9.6	--stiff, brownish gray, moist from 8-10 ft		2.0		28	72	22	50	0.85	94	
	--firm, grayish brown from 10-12 ft		1.5								
12.8	--stiff, grayish tan from 13-15 ft		2.0		30						
16											
19.2	--brownish gray from 18-20 ft		2.75								
22.4											
	--grayish tan, moist from 23-30 ft		2.75								
25.6											
28.8	--stiff		2.75								
	Boring terminated at 30.91 feet.										

This information pertains only to this boring location and should not be interpreted as being indicative of the whole site

WATER LEVEL MEASUREMENTS (ft.)

Initial: Dry

After 15 mins: Dry

DATE DRILLED: 10-16-2019

Plate: 6

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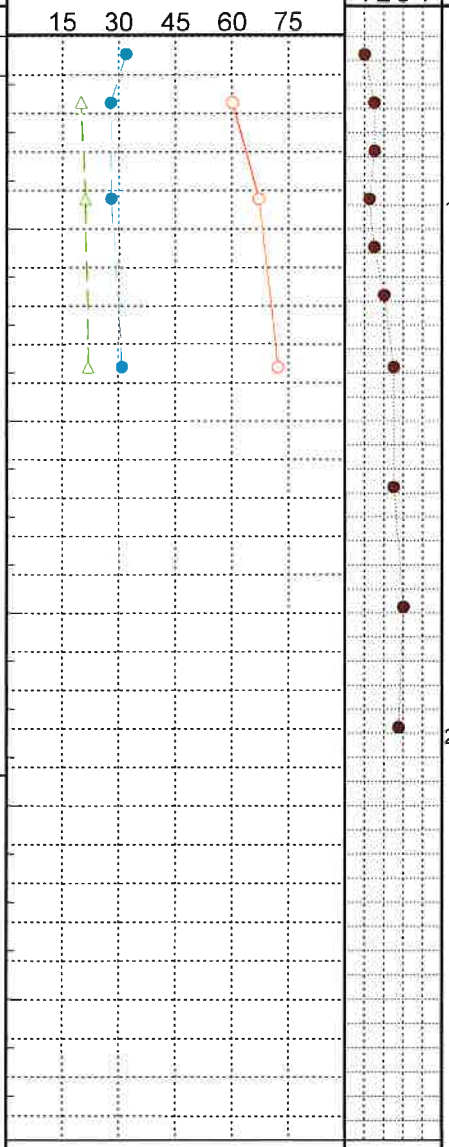
LOG OF BORING: B-5

Project: Proposed Galveston County Road & Bridge Facility, Dickenson,TX
Client: Page, Inc.
Location: Galveston County Road & Bridge Facility
Driller: Van & Sons
Easting: **Northing:**

Project NO.: EE-1919908-G
Drilling Depth (ft): 30.75
Elevation (ft):
Logged By: Raul G.
Weather:

DEPTH (ft)	Description Surface Elevation: Existing	USCS	PPEN (tsf)	SPT (Blows/ft)	M. Content (%)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	Cohesion (KSF)	Dry Density (PCF)	<#200 Sieve
0	4 inches Asphalt and 5" balckbase										
	FAT CLAY, firm, dark gray, moist	CH	1.0		32						
3.2	--root fibers from 0-4 ft		1.5		28	60	20	40			
			1.5								
6.4	--calcareous nodules from 6-10 ft		1.25		28	67	21	46			
9.6	-- firm, brownish gray		1.5								
	-- stiff, grayish brown from 10-12 ft		2.0								
12.8	--grayish tan from 13-15 ft		2.5		31	72	22	50			
16											
19.2	brownish gray, moist from 18-20 ft		2.5								
22.4											
	--very stiff from 23-25 ft		3.0								
25.6											
28.8	--stiff brownish gray --sand pockets		2.75								
	Boring terminated at 30.75 feet.										

Test Result Curves



This information pertains only to this boring location and should not be interpreted as being indicative of the whole site

WATER LEVEL MEASUREMENTS (ft.)

Initial: Dry

After 15 mins:

DATE DRILLED: 10-16-2019

Plate: 7

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LOG OF BORING: B-6

Project: Proposed Galveston County Road & Bridge Facility, Dickenson,TX
Project NO.: EE-1919908-G
Client: Page, Inc.
Drilling Depth (ft): 30
Location: Galveston County Road & Bridge Facility
Elevation (ft):
Driller: Van & Sons
Logged By: Raul G.
Easting: **Northing:** **Weather:**

Test Result Curves: Plastic Limit △, Liquid Limit ○, Blow Counts ⌖, Moisture Content ●; 15 30 45 60 75

PPEN Curve: 1 2 3 4

DEPTH (ft)	Description / Surface Elevation: Existing	USCS	PPEN (tsf)	SPT (Blows/ft)	M. Content (%)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	Cohesion (KSF)	Dry Density (PCF)	<#200 Sieve
0	FAT CLAY, stiff, dark gray, moist	CH	2.25		26	52	19	33			
			1.5								
3.2	-- ferrous srtains from 4-6 ft		1.75		32	77	23	54			
6.4	-- tan gray from 6-8 ft		2.0								
	-- calcareous nodules from 6-20 ft -- very stiff from 8-10 ft		3.0		23	55	20	35			
9.6	-- grayish brown from 10-15 ft		2.5								
12.8	-- stiff below 13 ft		2.5		32				0.62	93	
16											
19.2			2.5		29				1.25	95	
22.4			3.5								
25.6											
▼ 28.8	-- very stiff below 28 ft		3.0								
	Boring terminated at 30 feet.										

This information pertains only to this boring location and should not be interpreted as being indicative of the whole site

WATER LEVEL MEASUREMENTS (ft.)

DATE DRILLED: 10-15-2019

▽ **Initial:** Dry

▼ **After 15 mins:** 28' 1"

Plate: 8

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LOG OF BORING: B-7

Project: Proposed Galveston County Road & Bridge Facility, Dickenson,TX
Client: Page, Inc.
Location: Galveston County Road & Bridge Facility
Driller: Van & Sons
Easting: **Northing:**

Project NO.: EE-1919908-G
Drilling Depth (ft): 40
Elevation (ft):
Logged By: Raul G.
Weather:

Test Result Curves: Plastic Limit, Liquid Limit, Blow Counts, Moisture Content (15 30 45 60 75)

PPEN Curve (1 2 3 4)

DEPTH (ft)	Description / Surface Elevation: Existing	USCS	PPEN (tsf)	SPT (Blows/ft)	M. Content (%)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	Cohesion (KSF)	Dry Density (PCF)	<#200 Sieve
0	FAT CLAY, firm, dark gray, moist	CH	1.25		48	76	23	53			
	--roots from 0-2 ft		0.75								
3.2	--shell from 0-2 ft -- soft from 2-4 ft		1.25		32	74	23	51			
6.4	-- calcareous nodules from 4-20 ft -- very stiff from 6-10 ft		3.0								
	-- grayish brown from 8-13 ft		4.5		21	73	22	51	2.5	106	
9.6			4.25								
12.8	-- stiff below 13 ft		2.75		32				1.25	91	
16											
19.2			2.5								
22.4	-- very stiff grayish brown below 23 ft		3.0		27						
25.6											
28.8			3.50								
32	-- stiff below 33 ft		2.5								
35.2											
38.4	-- stiff, moist below 38 ft		3.0								
	Boring terminated at 40 feet.										

This information pertains only to this boring location and should not be interpreted as being indicative of the whole site

WATER LEVEL MEASUREMENTS (ft.)

Initial: **After 15 mins:**

DATE DRILLED: 10-16-2019

Plate: 9

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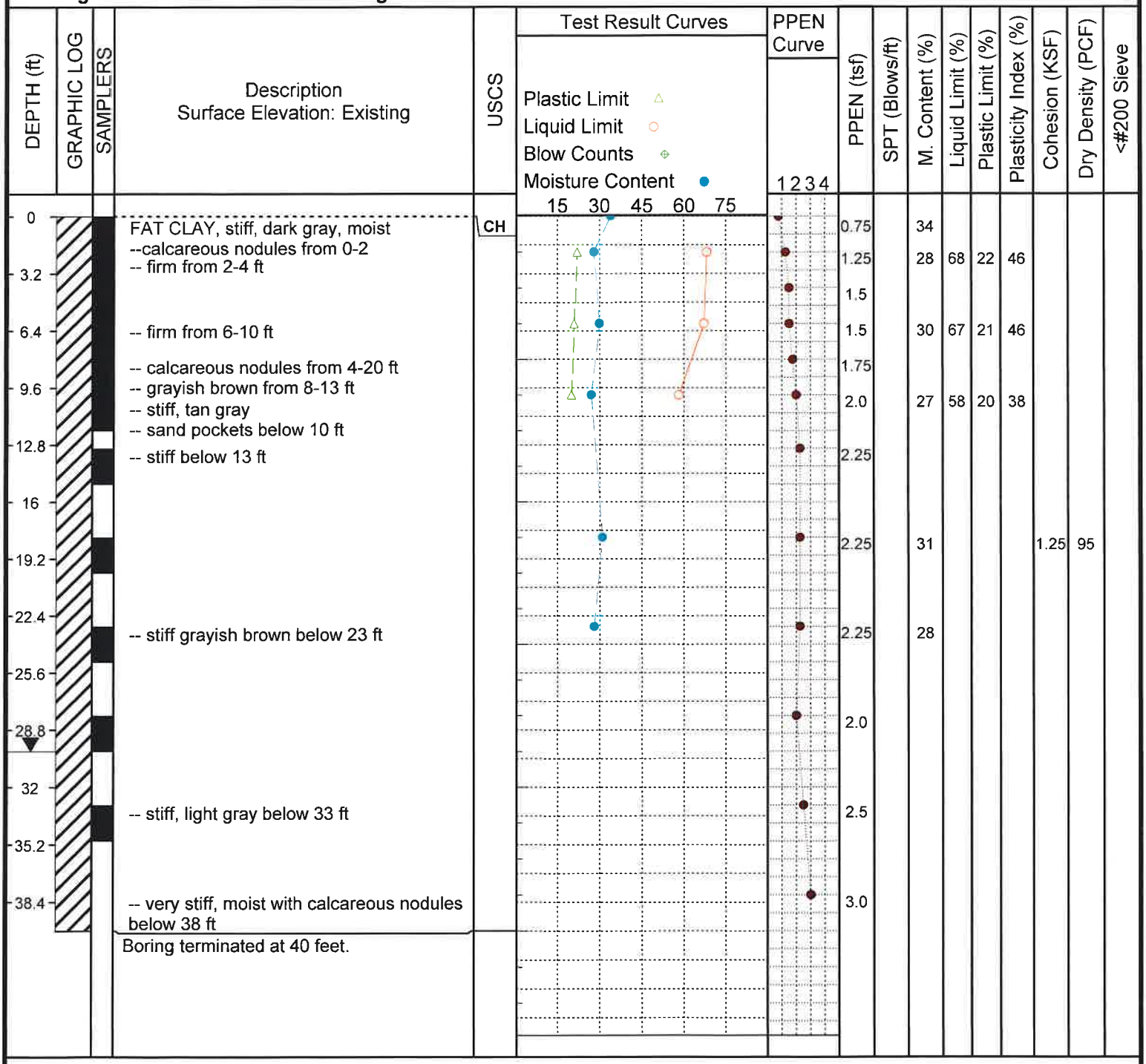
LOG OF BORING: B-8

Project: Proposed Galveston County Road & Bridge Facility, Dickenson,TX
Project NO.: EE-1919908-G
Client: Page, Inc.
Drilling Depth (ft): 40
Location: Galveston County Road & Bridge Facility
Elevation (ft):
Driller: Van & Sons
Logged By: Raul G.
Easting: **Northing:** **Weather:**



DEPTH (ft)	Description / Surface Elevation: Existing	USCS	PPEN (tsf)	SPT (Blows/ft)	M. Content (%)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	Cohesion (KSF)	Dry Density (PCF)	<#200 Sieve
0	FAT CLAY, stiff, dark gray, moist	CH	0.75		34						
	--calcareous nodules from 0-2										
3.2	-- firm from 2-4 ft		1.25		28	68	22	46			
			1.5								
6.4	-- firm from 6-10 ft		1.5		30	67	21	46			
	-- calcareous nodules from 4-20 ft		1.75								
9.6	-- grayish brown from 8-13 ft -- stiff, tan gray		2.0		27	58	20	38			
	-- sand pockets below 10 ft										
12.8	-- stiff below 13 ft		2.25								
16											
19.2			2.25		31				1.25	95	
22.4	-- stiff grayish brown below 23 ft		2.25		28						
25.6											
28.8			2.0								
32	-- stiff, light gray below 33 ft		2.5								
35.2											
38.4	-- very stiff, moist with calcareous nodules below 38 ft		3.0								
	Boring terminated at 40 feet.										

This information pertains only to this boring location and should not be interpreted as being indicative of the whole site

WATER LEVEL MEASUREMENTS (ft.)		DATE DRILLED: 10-16-2019
Initial: Dry	After 15 mins: 30' 4"	Plate: 10

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KEY TO LOG TERMS AND SYMBOLS

SOIL TYPE

ROCK | GRAVEL | SAND | SILT | CLAY | PEAT

MODIFIERS

STONE | GRAVELY | SANDY | SILTY | CLAYEY | FILL

SAMPLER TYPE

NO SAMPLE | AUGER SAMPLE | SHELBY TUBE | SPLIT SPOON

NO RECOVERY | ROCK CORE | 2" SHELBY TUBE | TXDOT CONE

UNIFIED SOIL CLASSIFICATION SYSTEM - ASTM D 2487

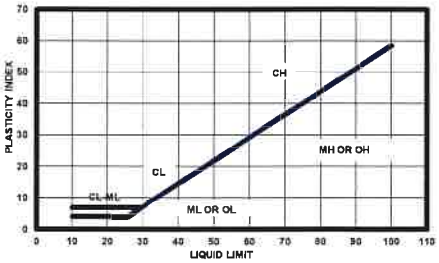
MAJOR DIVISIONS			LETTER SYMBOL	TYPICAL DESCRIPTIONS
COARSE GRAINED SOILS LESS THAN 50% PASSING NO. 200 SIEVE	GRAVEL & GRAVELY SOILS LESS THAN 50% PASSING NO. 4 SIEVE	CLEAN GRAVELS (LITTLE OR NO FINES	GW	WELL GRADED GRAVELS, GRAVEL-SAND MIXTURES WITH LITTLE OR NO FINES
			GP	POORLY GRADED GRAVELS, GRAVEL-SAND MIXTURES WITH LITTLE OR NO FINES
		W/ APPRECIATE-BLE FINES	GM	SILTY GRAVELS, GRAVEL-SAND-SILT MIXTURES
			GC	CLAYEY GRAVELS,GRAVEL-SAND-CLAY MIXTURES
	SANDS MORE THAN 50% PASSING NO. 4 SIEVE	CLEAN SANDS LITTLE FINES	SW	WELL GRADED SAND, GRAVELY SAND (LITTLE FINES)
			SP	POORLY GRADED SANDS, GRAVELY SAND (L FINES)
		SANDS WITH APPREA. FINES	SM	SILTY SANDS, SAND-SILT MIXTURES
			SC	CLAYEY SANDS,SAND-CLAY MIXTURES
FINE GRAINED SOILS LESS THAN 50% PASSING NO. 200 SIEVE	SILTS AND CLAYS LIQUID LIMIT LESS THAN 50		ML	INORGANIC SILTS & VERY FINE SANDS,ROCK FLOUR SILTY OR CLAYEY FINE SANDS OR CLAYEY SILT W/PI
			CL	INORGANIC CLAY OF LOW TO MEDIUM PI LEAN CLAY GRAVELY CLAYS, SANDY CLAYS, SILTY CLAYS
			OL	ORGANIC SILTS & ORGANIC SILTY CLAYS OF LOW PI
	SILTS AND CLAYS LIQUID LIMIT GREATER THAN 50		MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SANDY OR SILTY SOILS, ELASTIC SILTS
			CH	INORGANIC CLAYS OF HIGH PLASTICITY FAT CLAYS
			OH	ORGANIC CLAYS OF MED TO HIGH PI, ORGANIC SILT
HIGHLY ORGANIC SOIL			PT	PEAT AND OTHER HIGHLY ORGANIC SOILS
UNCLASSIFIED FILL MATERIALS			ARTIFICIALLY DEPOSITED AND OTHER UNCLASSIFIED SOILS FILL MATERIALS	

CONSISTENCY OF COHESIVE SOILS

CONSISTENCY	UNCONIFINED COMP. STRENGTH IN TSF
VERY SOFT	0 TO 0.25
SOFT	0.25 TO 1.0
FIRM	1.0 TO 1.75
STIFF	1.75 TO 3
VERY STIFF	3.0 TO 4.5
HARD	4.5+

RELATIVE DENSITY - GRANULAR SOILS

CONSISTENCY	N-VALUE (BLOWS PER FT)
VERY LOOSE	0-4
LOOSE	4-9
MEDIUM DENSE	10-29
DENSE	30-49
VERY DENSE	> 50 OR 50+



CLASSIFICATION OF GRANULAR SOILS

U.S. STANDARD SIEVE SIZE(S)

6" | 3" | 3/4" | 4 | 10 | 40 | 200

BOUL-DERS	COBBLES	GRAVEL COARSE	GRAVEL FINE	SAND COARSE	SAND MEDIUM	SAND FINE	SILT OR CLAY	CLAY

152 | 76.2 | 19.1 | 4.76 | 2.0 | 0.42 | 0.074 | 0.002

GRAIN SIZE IN MM

SECTION 012500 - SUBSTITUTION PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for substitutions.

B. Related Requirements:

1. Section 016000 "Product Requirements" for requirements for submitting comparable product submittals for products by listed manufacturers.

1.2 DEFINITIONS

A. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents and proposed by Contractor.

1. Substitutions for Cause: Changes proposed by Contractor that are required due to changed Project conditions, such as unavailability of product, regulatory changes, or unavailability of required warranty terms.
2. Substitutions for Convenience: Changes proposed by Contractor or Owner that are not required in order to meet other Project requirements but may offer advantage to Contractor or Owner.

1.3 ACTION SUBMITTALS

A. Substitution Requests: Submit a request for each substitution. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.

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

i. Research reports evidencing compliance with building code in effect for Project, from ICC-ES.
j. Detailed comparison of Contractor's construction schedule using proposed substitutions with products specified for the Work, including effect on the overall Contract Time. If specified product or method of construction cannot be provided within the Contract Time, include letter from manufacturer, on manufacturer's letterhead, stating date of receipt of purchase order, lack of availability, or delays in delivery.
k. Cost information, including a proposal of change, if any, in the Contract Sum.
l. Contractor's certification that proposed substitution complies with requirements in the Contract Documents, except as indicated in substitution request, is compatible with related materials and is appropriate for applications indicated.
m. Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of failure of proposed substitution to produce indicated results.

3. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within seven days of receipt of a request for substitution. Architect will notify Contractor of acceptance or rejection of proposed substitution within 15 days of receipt of request, or seven days of receipt of additional information or documentation, whichever is later.
   a. Forms of Acceptance: Change Order, Construction Change Directive, or Architect's Supplemental Instructions for minor changes in the Work.
   b. Use product specified if Architect does not issue a decision on use of a proposed substitution within time allocated.

1.4 QUALITY ASSURANCE

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

1.5 PROCEDURES

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

1.6 SUBSTITUTIONS

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

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

h. If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.

B. Substitutions for Convenience: Architect will consider requests for substitution if received within 60 days after the Notice to Proceed. Requests received after that time may be considered or rejected at discretion of Architect.

1. Conditions: Architect will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Architect will return requests without action, except to record noncompliance with these requirements:
   a. Requested substitution offers Owner a substantial advantage in cost, time, energy conservation, or other considerations, after deducting additional responsibilities Owner must assume. Owner's additional responsibilities may include compensation to Architect for redesign and evaluation services, increased cost of other construction by Owner, and similar considerations.
   b. Requested substitution does not require extensive revisions to the Contract Documents.
   c. Requested substitution is consistent with the Contract Documents and will produce indicated results.
   d. Substitution request is fully documented and properly submitted.
   e. Requested substitution will not adversely affect Contractor's construction schedule.
   f. Requested substitution has received necessary approvals of authorities having jurisdiction.
   g. Requested substitution is compatible with other portions of the Work.
   h. Requested substitution has been coordinated with other portions of the Work.
   i. Requested substitution provides specified warranty.
   j. If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 012500

SUBSTITUTION REQUEST

SUBSTITUTION REQUEST NO.

PROJECT	ARCHITECT'S PROJECT NO.

CHECK APPROPRIATE BOX

☐ SUBSTITUTION PRIOR TO BID OPENING (Minimum of 5 working days prior to receipt of bids per Instructions To Bidders)

☐ SUBSTITUTION FOLLOWING AWARD (Maximum of 20 working days from Notice To Proceed per Section 016000)

FROM BIDDER/CONTRACTOR (Print Company Name)

TO ARCHITECT/ENGINEER (Print Company name)

Bidder/contractor hereby requests acceptance of the following product or systems as a substitution in accordance with the provisions of the Contract Documents:

SPECIFICATION TITLE		DESCRIPTION
SECTION NO.	ARTICLE/PARAGRAPH	☐ Point-by-point comparison attached – **REQUIRED BY A/E**

Reason for not providing specified item:

_____

_____

QUALITY COMPARISON

	SPECIFIED PRODUCT	PROPOSED SUBSTITUTION
MANUFACTURER		
NAME, BRAND		
CATALOG/MODEL NO.		
VENDOR/DISTRIBUTOR		
MANUFACTURING LOCATION		
WARRANTY		

DOCUMENTED YEARS PROPOSED PRODUCT HAS BEEN MANUFACTURED

☐ New Product ☐ 2 - 5 years old ☐ 5 - 10 years old ☐ More than 10 years old

SUPPORTING DATA ATTACHED

☐ Drawings ☐ Product Data ☐ Samples ☐ Tests ☐ Reports ☐ Other

Differences between proposed substitution and specified product:

_____

_____

Proposed substitution affects other parts of Work: ☐ No ☐ Yes, explain:

_____

_____

Substitution requires dimensional revision or redesign of structure or A/E work: ☐ No ☐ Yes, explain:

_____

_____

Savings to Owner for accepting substitution: _____($_____)

Proposed substitution changes Contract Time: ☐ No ☐ Yes [Add] [Deduct] _____days

PREVIOUS INSTALLATIONS OF PROPOSED PRODUCT (Provide three, minimum)

PROJECT		ARCHITECT/ENGINEER	PHONE NO.
LOCATION	DATE INSTALLED	OWNER	PHONE NO.
PROJECT		ARCHITECT/ENGINEER	PHONE NO.
LOCATION	DATE INSTALLED	OWNER	PHONE NO.
PROJECT		ARCHITECT/ENGINEER	PHONE NO.
LOCATION	DATE INSTALLED	OWNER	PHONE NO.

STATEMENT OF CONFORMANCE

The Undersigned certifies:

- Proposed substitution has been fully investigated and determined to be equal or superior in all respects to specified product.
- Same warranty will be furnished for proposed substitution as for specified product.
- Same maintenance service and source of replacement parts, as applicable, is available.
- Proposed substitution will have no adverse effect on other trades and will not affect or delay progress schedule.
- Cost data as stated above is complete. Claims for additional costs related to accepted substitution which may subsequently become apparent are to be waived.
- Proposed substitution does not affect dimensions and functional clearances.
- Payment will be made for changes to building design, including A/E design, detailing, and construction costs caused by the substitution.
- Coordination, installation, and changes in the Work as necessary for accepted substitution will be complete in all respects.

SUBMITTED BY	DATE
SIGNATURE	FIRM

ADDITIONAL COMMENTS

_____

_____

_____

_____

_____

_____

☐ Contractor ☐ Subcontractor ☐ Supplier ☐ Manufacturer ☐ A/E ☐ Other _____

REVIEW AND ACTION (For A/E Use only)

☐ Substitution is not accepted.

☐ Substitution is accepted.

☐ Substitution is accepted with the following comments:

_____

_____

☐ Resubmit substitution request with the following additional information:

_____

_____

REVIEWED BY	DATE
SIGNATURE	FIRM

SECTION 012600 - CONTRACT MODIFICATION PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for handling and processing Contract modifications.

B. Related Requirements:

1. Section 012500 "Substitution Procedures" for administrative procedures for handling requests for substitutions made after the Contract award.

1.2 MINOR CHANGES IN THE WORK

A. Architect will issue supplemental instructions authorizing minor changes in the Work, not involving adjustment to the Contract Sum or the Contract Time, on AIA Document G710.

1.3 PROPOSAL REQUESTS

A. Owner-Initiated Proposal Requests: Architect will issue a detailed description of proposed changes in the Work that may require adjustment to the Contract Sum or the Contract Time. If necessary, the description will include supplemental or revised Drawings and Specifications.

1. Work Change Proposal Requests issued by Architect are for information only. Do not consider them instructions either to stop work in progress or to execute the proposed change.
2. Within time specified in Proposal Request or 20 days after receipt of Proposal Request, when not otherwise specified, submit a quotation estimating cost adjustments to the Contract Sum and the Contract Time necessary to execute the change.
   a. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
   b. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
   c. Include costs of labor and supervision directly attributable to the change.
   d. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
   e. Quotation Form: Use forms acceptable to Architect.

B. Contractor-Initiated Proposals: If latent or changed conditions require modifications to the Contract, Contractor may initiate a claim by submitting a request for a change to Architect.

1. Include a statement outlining reasons for the change and the effect of the change on the Work. Provide a complete description of the proposed change. Indicate the effect of the proposed change on the Contract Sum and the Contract Time.
2. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.

3. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
4. Include costs of labor and supervision directly attributable to the change.
5. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
6. Comply with requirements in Section 012500 "Substitution Procedures" if the proposed change requires substitution of one product or system for product or system specified.
7. Proposal Request Form: Use AIA Document G709 or form acceptable to Architect.

1.4 ADMINISTRATIVE CHANGE ORDERS

A. Allowance Adjustment: See Section 012100 "Allowances" for administrative procedures for preparation of Change Order Proposal for adjusting the Contract Sum to reflect actual costs of allowances.

B. Unit-Price Adjustment: See Section 012200 "Unit Prices" for administrative procedures for preparation of Change Order Proposal for adjusting the Contract Sum to reflect measured scope of unit-price work.

1.5 CHANGE ORDER PROCEDURES

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

1.6 CONSTRUCTION CHANGE DIRECTIVE

A. Construction Change Directive: Architect may issue a Construction Change Directive on AIA Document G714. Construction Change Directive instructs Contractor to proceed with a change in the Work, for subsequent inclusion in a Change Order.

1. Construction Change Directive contains a complete description of change in the Work. It also designates method to be followed to determine change in the Contract Sum or the Contract Time.

B. Documentation: Maintain detailed records on a time and material basis of work required by the Construction Change Directive.

1. After completion of change, submit an itemized account and supporting data necessary to substantiate cost and time adjustments to the Contract.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 012600

SECTION 012900 - PAYMENT PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements necessary to prepare and process Applications for Payment.

B. Related Requirements:

1. Section 012600 "Contract Modification Procedures" for administrative procedures for handling changes to the Contract.
2. Section 013200 "Construction Progress Documentation" for administrative requirements governing the preparation and submittal of the Contractor's construction schedule.

1.2 SCHEDULE OF VALUES

A. Coordination: Coordinate preparation of the schedule of values with preparation of Contractor's construction schedule.

1. Coordinate line items in the schedule of values with items required to be indicated as separate activities in Contractor's construction schedule.
2. Submit the schedule of values to Architect at earliest possible date, but no later than seven days before the date scheduled for submittal of initial Applications for Payment.
3. Subschedules for Separate Elements of Work: Where the Contractor's construction schedule defines separate elements of the Work, provide subschedules showing values coordinated with each element.

B. Format and Content: Use Project Manual table of contents as a guide to establish line items for the schedule of values. Provide at least one line item for each Specification Section.

1. Identification: Include the following Project identification on the schedule of values:
   a. Project name and location.
   b. Name of Architect.
   c. Architect's Project number.
   d. Contractor's name and address.
   e. Date of submittal.
2. Arrange schedule of values consistent with format of AIA Document G703.
3. Arrange the schedule of values in tabular form, with separate columns to indicate the following for each item listed:
   a. Related Specification Section or Division.
   b. Description of the Work.
   c. Name of subcontractor.
   d. Name of manufacturer or fabricator.
   e. Name of supplier.
   f. Change Orders (numbers) that affect value.
   g. Dollar value of the following, as a percentage of the Contract Sum to nearest one-hundredth percent, adjusted to total 100 percent. Round dollar amounts to whole dollars, with total equal to Contract Sum.
      1) Labor.
      2) Materials.
      3) Equipment.

4. Provide a breakdown of the Contract Sum in enough detail to facilitate continued evaluation of Applications for Payment and progress reports. Provide multiple line items for principal subcontract amounts in excess of five percent of the Contract Sum.
5. Provide a separate line item in the schedule of values for each part of the Work where Applications for Payment may include materials or equipment purchased or fabricated and stored, but not yet installed.
   a. Differentiate between items stored on-site and items stored off-site. Include requirements for insurance and bonded warehousing, if required.
6. Allowances: Provide a separate line item in the schedule of values for each allowance.
7. For each item of work in the schedule of values, provide a separate line item for initial cost of materials, for amount of each subsequent stage of completion, and for total installed value.
8. Overhead Costs: Show cost of temporary facilities and other major cost items that are not direct cost of actual work-in-place either as separate line items or distributed as general overhead expense, at Contractor's option.
9. Schedule of Values Revisions: Revise the schedule of values when Change Orders or Construction Change Directives result in a change in the Contract Sum. Include at least one separate line item for each Change Order and Construction Change Directive.

1.3 APPLICATIONS FOR PAYMENT

A. Each Application for Payment following the initial Application for Payment shall be consistent with previous applications and payments as certified by Architect and paid for by Owner.

   1. The initial Application for Payment, the Application for Payment at time of Substantial Completion, and the final Application for Payment involve additional requirements.

B. Payment Application Times: The period of construction work covered by each Application for Payment is the period indicated in the Agreement between Owner and Contractor.

   1. Submit draft copy of Application for Payment seven days prior to due date for review by Architect.

C. Application for Payment Forms: Use AIA Document G702 and AIA Document G703 as form for Applications for Payment.

D. Application Preparation: Complete every entry on form. Notarize and execute by a person authorized to sign legal documents on behalf of Contractor. Architect will return incomplete applications without action.

   1. Entries shall match data on the schedule of values and Contractor's construction schedule. Use updated schedules if revisions were made.
   2. Include amounts for work completed following previous Application for Payment, whether or not payment has been received. Include only amounts for work completed at time of Application for Payment.
   3. Include amounts of Change Orders and Construction Change Directives issued before last day of construction period covered by application.

E. Stored Materials: Include in Application for Payment amounts applied for materials or equipment purchased or fabricated and stored off-site.

   1. Provide certificate of insurance, evidence of transfer of title to Owner, and consent of surety to payment for stored materials.

2. Provide supporting documentation that verifies amount requested, such as paid invoices. Match amount requested with amounts indicated on documentation; do not include overhead and profit on stored materials.
3. Provide summary documentation for stored materials indicating the following:
   a. Value of materials previously stored and remaining stored as of date of previous Applications for Payment.
   b. Value of previously stored materials put in place after date of previous Application for Payment and on or before date of current Application for Payment.
   c. Value of materials stored since date of previous Application for Payment and remaining stored as of date of current Application for Payment.

F. Transmittal: Submit three signed and notarized original copies of each Application for Payment to Architect by a method ensuring receipt within 24 hours. One copy shall include waivers of lien and similar attachments if required.

1. Transmit each copy with a transmittal form listing attachments and recording appropriate information about application.

G. Initial Application for Payment: Administrative actions and submittals that must precede or coincide with submittal of first Application for Payment include the following:

1. List of subcontractors.
2. Schedule of values.
3. Contractor's construction schedule (preliminary if not final).
4. Submittal schedule (preliminary if not final).
5. Copies of building permits, authorizations, and licenses from authorities having jurisdiction for performance of the Work.
6. Initial progress report.
7. Report of preconstruction conference.
8. Certificates of insurance and insurance policies.
9. Performance and payment bonds.
10. Data needed to acquire Owner's insurance.

H. Application for Payment at Substantial Completion: After Architect issues the Certificate of Substantial Completion, submit an Application for Payment showing 100 percent completion for portion of the Work claimed as substantially complete.

1. Include documentation supporting claim that the Work is substantially complete and a statement showing an accounting of changes to the Contract Sum.
2. This application shall reflect Certificate(s) of Partial Substantial Completion issued previously for Owner occupancy of designated portions of the Work.

I. Final Payment Application: After completing Project closeout requirements, submit final Application for Payment with releases and supporting documentation not previously submitted and accepted, including, but not limited, to the following:

1. Evidence of completion of Project closeout requirements – see Section 017700 “Closeout Procedures.”
2. Insurance certificates for products and completed operations where required and proof that taxes, fees, and similar obligations were paid.
3. Updated final statement, accounting for final changes to the Contract Sum.
4. AIA Document G706 – Affidavit of Payment of Debts & Claims.
5. AIA Document G706A – Contractor’s Affidavit of Release of Liens.
6. AIA Document G707 – Consent of Surety to Final Payment.
7. Evidence that claims have been settled.

8. Final meter readings for utilities, a measured record of stored fuel, and similar data as of date of Substantial Completion or when Owner took possession of and assumed responsibility for corresponding elements of the Work.
9. Final liquidated damages settlement statement.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 012900

SECTION 013100 - PROJECT MANAGEMENT AND COORDINATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative provisions for coordinating construction operations on Project including, but not limited to, the following:

1. General coordination procedures.
2. Coordination drawings.
3. RFIs.
4. Digital project management procedures.
5. Project meetings.

B. Related Requirements:

1. Section 013200 "Construction Progress Documentation" for preparing and submitting Contractor's construction schedule.
2. Section 017300 "Execution" for procedures for coordinating general installation and field-engineering services, including establishment of benchmarks and control points.
3. Section 017700 "Closeout Procedures" for coordinating closeout of the Contract.

1.2 DEFINITIONS

A. BIM: Building Information Modeling.

B. RFI: Request for Information. Request from Owner, Architect, or Contractor seeking information required by or clarifications of the Contract Documents.

1.3 INFORMATIONAL SUBMITTALS

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

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

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

1. Post copies of list in project meeting room, in temporary field office,and by each temporary telephone. Keep list current at all times.

1.4 GENERAL COORDINATION PROCEDURES

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

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

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

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

C. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities to avoid conflicts and to ensure orderly progress of the Work. Such administrative activities include, but are not limited to, the following:

1. Preparation of Contractor's construction schedule.
2. Preparation of the schedule of values.
3. Installation and removal of temporary facilities and controls.
4. Delivery and processing of submittals.
5. Progress meetings.
6. Preinstallation conferences.
7. Project closeout activities.
8. Startup and adjustment of systems.

D. Conservation: Coordinate construction activities to ensure that operations are carried out with consideration given to conservation of energy, water, and materials. Coordinate use of temporary utilities to minimize waste.

1.5 COORDINATION DRAWINGS

A. Coordination Drawings, General: Prepare coordination drawings according to requirements in individual Sections, and additionally where installation is not completely indicated on Shop Drawings, where limited space availability necessitates coordination, or if coordination is required to facilitate integration of products and materials fabricated or installed by more than one entity.

1. Content: Project-specific information, drawn accurately to a scale large enough to indicate and resolve conflicts. Do not base coordination drawings on standard printed data. Include the following information, as applicable:
   a. Use applicable Drawings as a basis for preparation of coordination drawings. Prepare sections, elevations, and details as needed to describe relationship of various systems and components.
   b. Coordinate the addition of trade-specific information to coordination drawings in a sequence that best provides for coordination of the information and resolution of conflicts between installed components before submitting for review.

c. Indicate functional and spatial relationships of components of architectural, structural, civil, mechanical, and electrical systems.
d. Indicate space requirements for routine maintenance and for anticipated replacement of components during the life of the installation.
e. Show location and size of access doors required for access to concealed dampers, valves, and other controls.
f. Indicate required installation sequences.
g. Indicate dimensions shown on Drawings. Specifically note dimensions that appear to be in conflict with submitted equipment and minimum clearance requirements. Provide alternative sketches to Architect indicating proposed resolution of such conflicts. Minor dimension changes and difficult installations will not be considered changes to the Contract.

B. Coordination Drawing Organization: Organize coordination drawings as follows:

1. Floor Plans and Reflected Ceiling Plans: Show architectural and structural elements, and mechanical, plumbing, fire-protection, fire-alarm, and electrical Work. Show locations of visible ceiling-mounted devices relative to acoustical ceiling grid. Supplement plan drawings with section drawings where required to adequately represent the Work.
2. Plenum Space: Indicate subframing for support of ceiling and wall systems, mechanical and electrical equipment, and related Work. Locate components within plenums to accommodate layout of light fixtures and other components indicated on Drawings. Indicate areas of conflict between light fixtures and other components.
3. Mechanical Rooms: Provide coordination drawings for mechanical rooms showing plans and elevations of mechanical, plumbing, fire-protection, fire-alarm, and electrical equipment.
4. Structural Penetrations: Indicate penetrations and openings required for all disciplines.
5. Mechanical and Plumbing Work: Show the following:
   a. Sizes and bottom elevations of ductwork, piping, and conduit runs, including insulation, bracing, flanges, and support systems.
   b. Dimensions of major components, such as dampers, valves, diffusers, access doors, cleanouts and electrical distribution equipment.
   c. Fire-rated enclosures around ductwork.
6. Electrical Work: Show the following:
   a. Runs of vertical and horizontal conduit 1-1/4 inchesin diameter and larger.
   b. Light fixture, exit light, emergency battery pack, smoke detector, and other fire-alarm locations.
   c. Panel board, switch board, switchgear, transformer, busway, generator, and motor-control center locations.
   d. Location of pull boxes and junction boxes, dimensioned from column center lines.
7. Review: Architect will review coordination drawings to confirm that in general the Work is being coordinated, but not for the details of the coordination, which are Contractor's responsibility. If Architect determines that coordination drawings are not being prepared in sufficient scope or detail, or are otherwise deficient, Architect will so inform Contractor, who shall make suitable modifications and resubmit.
8. Coordination Drawing Prints: Prepare coordination drawing prints according to requirements in Section 013300 "Submittal Procedures."

C. Coordination Digital Data Files: Prepare coordination digital data files according to the following requirements:

1. File Preparation Format: Contractor’s option.
2. File Submittal Format: Submit or post coordination drawing files using PDF format.

1.6 REQUEST FOR INFORMATION (RFI)

A. eneral: Immediately on discovery of the need for additional information, clarification, or interpretation of the Contract Documents, Contractor shall prepare and submit an RFI in the form specified.

1. Architect will return without response those RFIs submitted to Architect by other entities controlled by Contractor.
2. Coordinate and submit RFIs in a prompt manner so as to avoid delays in Contractor's work or work of subcontractors.

B. Content of the RFI: Include a detailed, legible description of item needing information or interpretation and the following:

1. Project name.
2. Project number.
3. Date.
4. Name of Contractor.
5. Name of Architect.
6. RFI number, numbered sequentially.
7. RFI subject.
8. Specification Section number and title and related paragraphs, as appropriate.
9. Drawing number and detail references, as appropriate.
10. Field dimensions and conditions, as appropriate.
11. Contractor's suggested resolution. If Contractor's suggested resolution impacts the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
12. Contractor's signature.
13. Attachments: Include sketches, descriptions, measurements, photos, Product Data, Shop Drawings, coordination drawings, and other information necessary to fully describe items needing interpretation.
    a. Include dimensions, thicknesses, structural grid references, and details of affected materials, assemblies, and attachments on attached sketches.

C. RFI Forms: AIA Document G716 or software-generated form with substantially the same content, acceptable to Architect.

1. Attachments shall be electronic files in PDF format.

D. Architect's Action: Architect will review each RFI, determine action required, and respond. Allow 3-5 working days for Architect's response for each RFI. RFIs received by Architect after 1:00 p.m. will be considered as received the following working day.

1. The following Contractor-generated RFIs will be returned without action:
    a. Requests for approval of submittals.
    b. Requests for approval of substitutions.
    c. Requests for approval of Contractor's means and methods.
    d. Requests for coordination information already indicated in the Contract Documents.
    e. Requests for adjustments in the Contract Time or the Contract Sum.
    f. Requests for interpretation of Architect's actions on submittals.
    g. Incomplete RFIs or inaccurately prepared RFIs.
2. Architect's action may include a request for additional information, in which case Architect's time for response will date from time of receipt by Architect of additional information.

3. Architect's action on RFIs that may result in a change to the Contract Time or the Contract Sum may be eligible for Contractor to submit Change Proposal according to Section 012600 "Contract Modification Procedures."
    a. If Contractor believes the RFI response warrants change in the Contract Time or the Contract Sum, notify Architect in writing within 10 days of receipt of the RFI response.

E. RFI Log: Prepare, maintain, and submit a tabular log of RFIs organized by the RFI number. Submit log weekly. Use software log that is part of web-based Project software. Include the following:

1. Project name.
2. Name and address of Contractor.
3. Name and address of Architect.
4. RFI number including RFIs that were returned without action or withdrawn.
5. RFI description.
6. Date the RFI was submitted.
7. Date Architect's response was received.
8. Identification of related Minor Change in the Work, Construction Change Directive, and Proposal Request, as appropriate.

F. On receipt of Architect's action, update the RFI log and immediately distribute the RFI response to affected parties. Review response and notify Architect within seven days if Contractor disagrees with response.

1.7 DIGITAL PROJECT MANAGEMENT PROCEDURES

A. Use of Architect's Digital Data Files: Digital data files of Architect's BIM model will be provided by Architect for Contractor's use during construction.

1. Digital data files may be used by Contractor in preparing coordination drawings, Shop Drawings, and Project record Drawings.
2. Architect makes no representations as to the accuracy or completeness of digital data files as they relate to Contract Drawings.
3. Digital Drawing Software Program: Contract Drawings are available in Revit 2016.
4. Contractor shall execute Architect’s data licensing agreement.
    a. Subcontractors and other parties granted access by Contractor to Architect's digital data files shall also execute Architect’s data licensing agreement.

B. Web-Based Project Software: All documents transmitted for purposes of administration of the contract shall be in electronic (PDF) format and transmitted via Architect's web-based Project software that receives, logs and stores documents, provides electronic stamping and signatures, and notivies addressees via email.

1. Besides submittals for review, information, and closeout, this procedure applies to requests for information (RFIs), progress documentation, contract modification documents (e.g. supplementary instructions, change proposals, change orders), field reports and meeting minutes, 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 PDF 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 PDF documents will not be reviewed.
7. All other specified submittal and document transmission procedures apply, except that electronic document requirements to not apply to samples or color selection charts.
8. Notarized documents, original requiring execution, and final pay applications shall be submitted by hand after electronic submittal.

C. Submittal Service: The selected service is:

1. Newforma Info Exchange.

D. 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.

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

1.8 PROJECT MEETINGS

A. General: Schedule and conduct meetings and conferences at Project site unless otherwise indicated.

1. Attendees: Inform participants and others involved, and individuals whose presence is required, of date and time of each meeting. Notify Owner and Architect of scheduled meeting dates and times a minimum of 10 working days prior to meeting.
2. Agenda: Prepare the meeting agenda. Distribute the agenda to all invited attendees.
3. Minutes: Entity responsible for conducting meeting will record significant discussions and agreements achieved. Distribute the meeting minutes to everyone concerned, including Owner and Architect, within three days of the meeting.

B. Preconstruction Conference: Schedule and conduct a preconstruction conference before starting construction, at a time convenient to Owner and Architect, but no later than 10 days after execution of the Agreement.

1. Attendees: Authorized representatives of Owner, Architect, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the conference. Participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
2. Agenda: Discuss items of significance that could affect progress, including the following:
   a. Responsibilities and personnel assignments.
   b. Tentative construction schedule.
   c. Critical work sequencing and long lead items.
   d. Designation of key personnel and their duties.
   e. Lines of communications.
   f. Use of web-based Project software.
   g. Procedures for processing field decisions and Change Orders.
   h. Procedures for RFIs.
   i. Procedures for testing and inspecting.
   j. Procedures for processing Applications for Payment.
   k. Distribution of the Contract Documents.
   l. Submittal procedures.

m. Preparation of Record Documents.
n. Use of the premises.
o. Work restrictions.
p. Work restrictions.
q. Working hours.
r. Owner's occupancy requirements.
s. Responsibility for temporary facilities and controls.
t. Procedures for moisture and mold control.
u. Procedures for disruptions and shutdowns.
v. Construction waste management and recycling.
w. Parking availability.
x. Office, work, and storage areas.
y. Equipment deliveries and priorities.
z. First aid.
aa. Security.
bb. Progress cleaning.

3. Minutes: Entity responsible for conducting meeting will record and distribute meeting minutes.

C. Preinstallation Conferences: Conduct a preinstallation conference at Project site before each construction activity that requires coordination with other construction.

1. Attendees: Installer and representatives of manufacturers and fabricators involved in or affected by the installation and its coordination or integration with other materials and installations that have preceded or will follow, shall attend the meeting. Advise Architect of scheduled meeting dates.
2. Agenda: Review progress of other construction activities and preparations for the particular activity under consideration, including requirements for the following:
   a. Contract Documents.
   b. Options.
   c. Related RFIs.
   d. Related Change Orders.
   e. Purchases.
   f. Deliveries.
   g. Submittals.
   h. Review of mockups.
   i. Possible conflicts.
   j. Compatibility requirements.
   k. Time schedules.
   l. Weather limitations.
   m. Manufacturer's written instructions.
   n. Warranty requirements.
   o. Compatibility of materials.
   p. Acceptability of substrates.
   q. Temporary facilities and controls.
   r. Space and access limitations.
   s. Regulations of authorities having jurisdiction.
   t. Testing and inspecting requirements.
   u. Installation procedures.
   v. Coordination with other work.
   w. Required performance results.
   x. Protection of adjacent work.
   y. Protection of construction and personnel.

3. Record significant conference discussions, agreements, and disagreements, including required corrective measures and actions.

4. Reporting: Distribute minutes of the meeting to each party present and to other parties requiring information.
5. Do not proceed with installation if the conference cannot be successfully concluded. Initiate whatever actions are necessary to resolve impediments to performance of the Work and reconvene the conference at earliest feasible date.

D. Progress Meetings: Conduct progress meetings at biweekly intervals.

1. Coordinate dates of meetings with preparation of payment requests.
2. Attendees: In addition to representatives of Owner and Architect, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.
3. Agenda: Review and correct or approve minutes of previous progress meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.
   a. Contractor's Construction Schedule: Review progress since the last meeting. Determine whether each activity is on time, ahead of schedule, or behind schedule, in relation to Contractor's construction schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.
      1) Review schedule for next period.
   b. Review present and future needs of each entity present, including the following:
      1) Interface requirements.
      2) Sequence of operations.
      3) Resolution of BIM component conflicts.
      4) Status of submittals.
      5) Construction waste management and recycling.
      6) Sequence of finish installation and indoor air quality procedures.
      7) Deliveries.
      8) Off-site fabrication.
      9) Access.
      10) Site use.
      11) Temporary facilities and controls.
      12) Work hours.
      13) Hazards and risks.
      14) Progress cleaning.
      15) Quality and work standards.
      16) Status of correction of deficient items.
      17) Field observations.
      18) Status of RFIs.
      19) Status of Proposal Requests.
      20) Pending changes.
      21) Status of Change Orders.
      22) Pending claims and disputes.
      23) Documentation of information for payment requests.
4. Minutes: Entity responsible for conducting the meeting will record and distribute the meeting minutes to each party present and to parties requiring information.
   a. Schedule Updating: Revise Contractor's construction schedule after each progress meeting where revisions to the schedule have been made or recognized. Issue

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 013100

SECTION 013200 - CONSTRUCTION PROGRESS DOCUMENTATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for documenting the progress of construction during performance of the Work, including the following:

1. Contractor's Construction Schedule.
2. Construction schedule updating reports.
3. Daily construction reports.
4. Site condition reports.
5. Unusual event reports.

B. Related Requirements:

1. Section 013300 "Submittal Procedures" for preparing the submittal schedule.

1.2 DEFINITIONS

A. Activity: A discrete part of a project that can be identified for planning, scheduling, monitoring, and controlling the construction Project. Activities included in a construction schedule consume time and resources.

1. Critical Activity: An activity on the critical path that must start and finish on the planned early start and finish times.
2. Predecessor Activity: An activity that precedes another activity in the network.
3. Successor Activity: An activity that follows another activity in the network.

B. CPM: Critical path method, which is a method of planning and scheduling a construction project where activities are arranged based on activity relationships. Network calculations determine when activities can be performed and the critical path of Project.

C. Critical Path: The longest connected chain of interdependent activities through the network schedule that establishes the minimum overall Project duration and contains no float.

D. Event: The starting or ending point of an activity.

E. Float: The measure of leeway in starting and completing an activity.

1. Float time is not for the exclusive use or benefit of either Owner or Contractor, but is a jointly owned, expiring Project resource available to both parties as needed to meet schedule milestones and Contract completion date.
2. Free float is the amount of time an activity can be delayed without adversely affecting the early start of the successor activity.
3. Total float is the measure of leeway in starting or completing an activity without adversely affecting the planned Project completion date.

F. Resource Loading: The allocation of manpower and equipment necessary for completing an activity as scheduled.

1.3 INFORMATIONAL SUBMITTALS

A. Format for Submittals: Submit required submittals in the following format:

1. PDF file.

B. Startup construction schedule.

C. Contractor's Construction Schedule: Initial schedule, of size required to display entire schedule for entire construction period.

D. Construction Schedule Updating Reports: Submit with Applications for Payment.

E. Daily Construction Reports: Submit upon request.

F. Site Condition Reports: Submit at time of discovery of differing conditions.

G. Unusual Event Reports: Submit at time of unusual event.

1.4 QUALITY ASSURANCE

A. Prescheduling Conference: Conduct conference at Project site to comply with requirements in Section 013100 "Project Management and Coordination." Review methods and procedures related to the preliminary construction schedule and Contractor's Construction Schedule, including, but not limited to, the following:

1. Review software limitations and content and format for reports.
2. Verify availability of qualified personnel needed to develop and update schedule.
3. Discuss constraints, including work stages area separations interim milestones and partial Owner occupancy.
4. Review delivery dates for Owner-furnished products.
5. Review schedule for work of Owner's separate contracts.
6. Review submittal requirements and procedures.
7. Review time required for review of submittals and resubmittals.
8. Review requirements for tests and inspections by independent testing and inspecting agencies.
9. Review time required for Project closeout and Owner startup procedures, including commissioning activities.
10. Review and finalize list of construction activities to be included in schedule.
11. Review procedures for updating schedule.

1.5 COORDINATION

A. Coordinate Contractor's Construction Schedule with the schedule of values, list of subcontracts, submittal schedule, progress reports, payment requests, and other required schedules and reports.

1. Secure time commitments for performing critical elements of the Work from entities involved.
2. Coordinate each construction activity in the network with other activities and schedule them in proper sequence.

1.6 CONTRACTOR'S CONSTRUCTION SCHEDULE, GENERAL

A. Computer Scheduling Software: Prepare schedules using current version of a program that has been developed specifically to manage construction schedules.

B. Time Frame: Extend schedule from date established for the Notice to Proceed to date of final completion.

1. Contract completion date shall not be changed by submission of a schedule that shows an early completion date, unless specifically authorized by Change Order.

C. Activities: Treat each floor or separate area as a separate numbered activity for each main element of the Work. Comply with the following:

1. Activity Duration: Define activities so no activity is longer than 21 days, unless specifically allowed by Architect.
2. Procurement Activities: Include procurement process activities for long lead items and major items, requiring a cycle of more than 60 days, as separate activities in schedule. Procurement cycle activities include, but are not limited to, submittals, approvals, purchasing, fabrication, and delivery.
3. Submittal Review Time: Include review and resubmittal times indicated in Section 013300 "Submittal Procedures" in schedule. Coordinate submittal review times in Contractor's Construction Schedule with submittal schedule.
4. Startup and Testing Time: Include no fewer than 7 days for startup and testing.
5. Substantial Completion: Indicate completion in advance of date established for Substantial Completion, and allow time for Architect's administrative procedures necessary for certification of Substantial Completion.
6. Punch List and Final Completion: Include not more than 30 days for completion of punch list items and final completion.

D. Constraints: Include constraints and work restrictions indicated in the Contract Documents and as follows in schedule, and show how the sequence of the Work is affected.

1. Phasing: Where Work consists of multiple phases, arrange list of activities on schedule by phase.
2. Work by Owner: Include a separate activity for each portion of the Work performed by Owner or Owner’s contractors or suppliers.
3. Products Ordered in Advance: Include a separate activity for each product.
4. Owner-Furnished Products: Include a separate activity for each product.
5. Work Restrictions: Show the effect of the following items on the schedule:
   a. Coordination with existing construction.
   b. Limitations of continued occupancies.
   c. Uninterruptible services.
   d. Partial occupancy before Substantial Completion.
   e. Use-of-premises restrictions.
   f. Provisions for future construction.
   g. Seasonal variations.
   h. Environmental control.

6. Work Stages: Where appropriate to the scope of Work, indicate important stages of construction for critical portions of the Work, including, but not limited to, the following:
   a. Mockups.
   b. Fabrication.
   c. Sample testing.
   d. Deliveries.
   e. Installation.

f. Tests and inspections.
g. Adjusting.
h. Curing.

7. Construction Areas: Identify each major area of construction for each major portion of the Work. Indicate where each construction activity within a major area must be sequenced or integrated with other construction activities to provide for the following:
   a. Structural completion.
   b. Permanent space enclosure.
   c. Completion of mechanical installation.
   d. Completion of electrical installation.
   e. Substantial Completion.

E. Milestones: Include milestones indicated in the Contract Documents in schedule, including, but not limited to, the Notice to Proceed, Substantial Completion, and final completion.

F. Upcoming Work Summary: Prepare summary report indicating activities scheduled to occur or commence prior to submittal of next schedule update. Summarize the following issues:

1. Unresolved issues.
2. Unanswered Requests for Information.
3. Rejected or unreturned submittals.
4. Notations on returned submittals.
5. Pending modifications affecting the Work and the Contract Time.

G. Contractor's Construction Schedule Updating: Prior to each regularly scheduled progress meeting, update schedule to reflect actual construction progress and activities. Issue schedule before each meeting.

1. Revise schedule immediately after each meeting or other activity where revisions have been recognized or made. Issue updated schedule concurrently with the report of each such meeting.
2. Include a report with updated schedule that indicates every change, including, but not limited to, changes in logic, durations, actual starts and finishes, and activity durations.
3. As the Work progresses, indicate final completion percentage for each activity.

H. Distribution: Distribute copies of approved schedule to Architect, Owner, separate contractors, testing and inspecting agencies, and other parties identified by Contractor with a need-to-know schedule responsibility.

1. Post copies in Project meeting rooms and temporary field offices.
2. When revisions are made, distribute updated schedules to the same parties and post in the same locations. Delete parties from distribution when they have completed their assigned portion of the Work and are no longer involved in performance of construction activities.

1.7 GANTT-CHART SCHEDULE REQUIREMENTS

A. Gantt-Chart Schedule: Submit a comprehensive, fully developed, horizontal, Gantt-chart-type, Contractor's Construction Schedule within 20 days of date established for the Notice to Proceed.

1. Base schedule on the startup construction schedule and additional information received since the start of Project.

B. Preparation: Indicate each significant construction activity separately. Identify first workday of each week with a continuous vertical line.

1. For construction activities that require three months or longer to complete, indicate an estimated completion percentage in 10 percent increments within time bar.

1.8 CPM SCHEDULE REQUIREMENTS

A. General: Prepare network diagrams using AON (activity-on-node) format.

B. Startup Network Diagram: Submit diagram within 14 days of date established for the Notice to Proceed. Outline significant construction activities for the first 60 days of construction. Include skeleton diagram for the remainder of the Work.

C. CPM Schedule: Prepare Contractor's Construction Schedule using a computerized, time-scaled CPM network analysis diagram for the Work.

1. Develop network diagram in sufficient time to submit CPM schedule so it can be accepted for use no later than 30 days after date established for the Notice to Proceed.
   a. Failure to include any work item required for performance of this Contract shall not excuse Contractor from completing all work within applicable completion dates.
2. Conduct educational workshops to train and inform key Project personnel, including subcontractors' personnel, in proper methods of providing data and using CPM schedule information.
3. Establish procedures for monitoring and updating CPM schedule and for reporting progress. Coordinate procedures with progress meeting and payment request dates.
4. Use "one workday" as the unit of time for individual activities. Indicate nonworking days and holidays incorporated into the schedule to coordinate with the Contract Time. Include list of nonworking days and holidays.

D. CPM Schedule Preparation: Prepare a list of all activities required to complete the Work. Using the startup network diagram, prepare a skeleton network to identify probable critical paths.

1. Activities: Indicate the estimated time duration, sequence requirements, and relationship of each activity in relation to other activities. Include estimated time frames for the following activities:
   a. Preparation and processing of submittals.
   b. Mobilization and demobilization.
   c. Purchase of materials.
   d. Delivery.
   e. Fabrication.
   f. Utility interruptions.
   g. Installation.
   h. Work by Owner or Owner’s contractors or suppliers that may affect or be affected by Contractor's activities.
   i. Testing and inspection.
   j. Commissioning.
   k. Punch list and final completion.
   l. Activities occurring following final completion.
2. Critical Path Activities: Identify critical path activities, including those for interim completion dates. Scheduled start and completion dates shall be consistent with Contract milestone dates.
3. Processing: Process data to produce output data on a computer-drawn, time-scaled network. Revise data, reorganize activity sequences, and reproduce as often as necessary to produce the CPM schedule within the limitations of the Contract Time.
4. Format: Mark the critical path. Locate the critical path near center of network; locate paths with most float near the edges.

a. Subnetworks on separate sheets are permissible for activities clearly off the critical path.

E. Contract Modifications: For each proposed contract modification and concurrent with its submission, prepare a time-impact analysis using a network fragment to demonstrate the effect of the proposed change on the overall Project schedule.

F. Initial Issue of Schedule: Prepare initial network diagram from a sorted activity list indicating straight "early start-total float." Identify critical activities. Prepare tabulated reports showing the following:

1. Contractor or subcontractor and the Work or activity.
2. Description of activity.
3. Main events of activity.
4. Immediate preceding and succeeding activities.
5. Early and late start dates.
6. Early and late finish dates.
7. Activity duration in workdays.
8. Total float or slack time.

G. Schedule Updating: Concurrent with making revisions to schedule, prepare tabulated reports showing the following:

1. Identification of activities that have changed.
2. Changes in early and late start dates.
3. Changes in early and late finish dates.
4. Changes in activity durations in workdays.
5. Changes in the critical path.
6. Changes in total float or slack time.
7. Changes in the Contract Time.

1.9 REPORTS

A. Daily Construction Reports: Prepare a daily construction report recording the following information concerning events at Project site:

1. List of subcontractors and separate contractors at Project site.
2. Approximate count of personnel at Project site.
3. Equipment at Project site.
4. Material deliveries.
5. High and low temperatures and general weather conditions, including presence of rain or snow.
6. Testing and inspection.
7. Accidents.
8. Meetings and significant decisions.
9. Unusual events.
10. Stoppages, delays, shortages, and losses.
11. Meter readings and similar recordings.
12. Emergency procedures.
13. Orders and requests of authorities having jurisdiction.
14. Changes received and implemented.
15. Construction Change Directives received and implemented.
16. Services connected and disconnected.
17. Equipment or system tests and startups.
18. Substantial Completions authorized.
19. Construction photographs, taken weekly.

B. Site Condition Reports: Immediately on discovery of a difference between site conditions and the Contract Documents, prepare and submit a detailed report. Submit with a Request for Information. Include a detailed description of the differing conditions, together with recommendations for changing the Contract Documents.

C. Unusual Event Reports: When an event of an unusual and significant nature occurs at Project site, whether or not related directly to the Work, prepare and submit a special report. List chain of events, persons participating, responses by Contractor's personnel, evaluation of results or effects, and similar pertinent information. Advise Owner in advance when these events are known or predictable.

1. Submit unusual event reports directly to Owner within one day of an occurrence. Distribute copies of report to parties affected by the occurrence.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 013200

SECTION 013300 - SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Submittal schedule requirements.
2. Administrative and procedural requirements for submittals.

B. Related Requirements:

1. Section 012900 "Payment Procedures" for submitting Applications for Payment and the schedule of values.
2. Section 013100 "Project Management and Coordination" for submitting coordination drawings and subcontract list and for requirements for web-based Project software.
3. Section 013200 "Construction Progress Documentation" for submitting schedules and reports, including Contractor's construction schedule.
4. Section 014000 "Quality Requirements" for submitting test and inspection reports, and schedule of tests and inspections.
5. Section 017700 "Closeout Procedures" for submitting closeout submittals and maintenance material submittals.
6. Section 017823 "Operation and Maintenance Data" for submitting operation and maintenance manuals.
7. Section 017839 "Project Record Documents" for submitting record Drawings, record Specifications, and record Product Data.

1.2 DEFINITIONS

A. Action Submittals: Written and graphic information and physical samples that require Architect's responsive action.

B. Informational Submittals: Written and graphic information and physical samples that do not require Architect's responsive action. Submittals may be rejected for not complying with requirements.

1.3 SUBMITTAL SCHEDULE

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

1. Coordinate submittal schedule with list of subcontracts, the schedule of values, and Contractor's construction schedule.
2. Initial Submittal: Submit concurrently with startup construction schedule. Include submittals required during the first 60 days of construction. List those submittals required to maintain orderly progress of the Work and those required early because of long lead time for manufacture or fabrication.
3. Final Submittal: Submit concurrently with the first complete submittal of Contractor's construction schedule.

a. Submit revised submittal schedule to reflect changes in current status and timing for submittals.

4. Format: Arrange the following information in a tabular format:
   a. Scheduled date for first submittal.
   b. Specification Section number and title.
   c. Name of subcontractor.
   d. Description of the Work covered.
   e. Scheduled date for Architect's final release or approval.

1.4 SUBMITTAL FORMATS

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

1. Project name.
2. Date.
3. Name of Architect.
4. Name of Contractor.
5. Name of firm or entity that prepared submittal.
6. Names of subcontractor, manufacturer, and supplier.
7. Unique submittal number, including revision identifier. Include Specification Section number with sequential alphanumeric identifier; and alphanumeric suffix for resubmittals.
8. Category and type of submittal.
9. Submittal purpose and description.
10. Number and title of Specification Section, with paragraph number and generic name for each of multiple items.
11. Drawing number and detail references, as appropriate.
12. Indication of full or partial submittal.
13. Location(s) where product is to be installed, as appropriate.
14. Other necessary identification.
15. Remarks.
16. Signature of transmitter.

B. Options: Identify options requiring selection by Architect.

C. Deviations and Additional Information: On each submittal, clearly indicate deviations from requirements in the Contract Documents, including minor variations and limitations; include relevant additional information and revisions, other than those requested by Architect on previous submittals. Indicate by highlighting on each submittal or noting on attached separate sheet.

D. Submittals for Web-Based Project Software: Prepare submittals as PDF files, or other format indicated by Project software website.

1.5 SUBMITTAL PROCEDURES

A. Prepare and submit submittals required by individual Specification Sections.

1. Web-Based Project Software: Prepare submittals in PDF form, and upload to web-based Project software website. Enter required data in web-based software site to fully identify submittal.

B. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.

1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
2. Submit all submittal items required for each Specification Section concurrently unless partial submittals for portions of the Work are indicated on approved submittal schedule.
3. Submit action submittals and informational submittals required by the same Specification Section as separate packages under separate transmittals.
4. Coordinate transmittal of submittals for related parts of the Work specified in different Sections so processing will not be delayed because of need to review submittals concurrently for coordination.
    a. Architect reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.

C. Processing Time: Allow time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Architect's receipt of submittal. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.

1. Initial Review: Allow 5-10 working days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. Architect will advise Contractor when a submittal being processed must be delayed for coordination.
2. Intermediate Review: If intermediate submittal is necessary, process it in same manner as initial submittal.
3. Resubmittal Review: Allow 5-10 working days for review of each resubmittal.
4. Concurrent Review: Where concurrent review of submittals by Architect’s, consultants, Owner, or other parties is requires, allow 10 days for initial review of each submittal. Specification Sections having submittals requiring concurrent review include, but are not limited to:
    a. Division 3 Sections for Cast-In-Place Concrete.
    b. Division 4 Sections for Masonry and Stonework.
    c. Division 5 Section for Structural Steel, Metal Deck, Cold Formed Metal Framing, Miscellaneous Metal Fabrications and Expansion Control.
    d. Division 7 Section for Waterproofing, Air Barriers, Roofing, Roof Specialties and Accessories.
    e. Division 8 Sections for Doors, Frames, Door Hardware, Storefronts, Curtain Walls, and Glazing.
    f. Division 11 Section for Electrically Operated Items of Equipment.
    g. Division 13 Sections for Lightning Protection and Other Special Construction.
    h. Division 14 Sections for Elevators
    i. Division 21, 22, and 23 Sections for Fire Protection Systems, Plumbing Fixtures and Trim, Air Distributions Devices, Sheet Metal Work and A/C Controls.
    j. Division 26 Sections for Wiring Devices, Lighting Fixtures, Fire Alarm and Detection System, Telephone System, Nurse Call System, and Intercommunication System.
    k. Division 31 Sections for Drainage and Containment.
    l. Division 32 Sections for Pavements and Planting.
    m. Division 32 Sections for Foundation & Load Bearing Elements.
    n. Division 33 Sections for Utility Services.

D. Resubmittals: Make resubmittals in same form as initial submittal.

1. Note date and content of previous submittal.
2. Note date and content of revision in label or title block and clearly indicate extent of revision.
3. Resubmit submittals until they are marked with approval notation from Architect's action stamp.

E. Distribution: Furnish copies of final submittals to manufacturers, subcontractors, suppliers, fabricators, installers, authorities having jurisdiction, and others as necessary for performance of construction activities. Show distribution on transmittal forms.

F. Use for Construction: Retain complete copies of submittals on Project site. Use only final action submittals that are marked with approval notation from Architect's action stamp.

1.6 SUBMITTAL REQUIREMENTS

A. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.

1. If information must be specially prepared for submittal because standard published data are unsuitable for use, submit as Shop Drawings, not as Product Data.
2. Mark each copy of each submittal to show which products and options are applicable.
3. Include the following information, as applicable:
   a. Manufacturer's catalog cuts.
   b. Manufacturer's product specifications.
   c. Standard color charts.
   d. Statement of compliance with specified referenced standards.
   e. Testing by recognized testing agency.
   f. Application of testing agency labels and seals.
   g. Notation of coordination requirements.
   h. Availability and delivery time information.
4. For equipment, include the following in addition to the above, as applicable:
   a. Wiring diagrams that show factory-installed wiring.
   b. Printed performance curves.
   c. Operational range diagrams.
   d. Clearances required to other construction, if not indicated on accompanying Shop Drawings.
5. Submit Product Data before Shop Drawings, and before or concurrent with Samples.

B. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data unless submittal based on Architect's digital data drawing files is otherwise permitted.

1. Electronic copies: Revit models of electronic copies of CAD Drawings of the Contract Drawings will not be provided by Architect for Contractor’s use in preparing submittals without a properly executed “PageSoutherlandPage Release Transfer of Electronic Documents”.
2. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:
   a. Identification of products.
   b. Schedules.
   c. Compliance with specified standards.
   d. Notation of coordination requirements.
   e. Notation of dimensions established by field measurement.
   f. Relationship and attachment to adjoining construction clearly indicated.
   g. Seal and signature of professional engineer if specified.

C. Samples: Submit Samples for review of kind, color, pattern, and texture for a check of these characteristics with other materials.

1. Transmit Samples that contain multiple, related components such as accessories together in one submittal package.
2. Identification: Permanently attach label on unexposed side of Samples that includes the following:
   a. Project name and submittal number.
   b. Generic description of Sample.
   c. Product name and name of manufacturer.
   d. Sample source.
   e. Number and title of applicable Specification Section.
   f. Specification paragraph number and generic name of each item.
3. Email Transmittal: Provide PDF transmittal. Include digital image file illustrating Sample characteristics, and identification information for record.
4. Web-Based Project Software: Submit transmittal in PDF form, and upload to web-based Project software website. Enter required data in web-based software site to fully identify submittal.
5. Disposition: Maintain sets of approved Samples at Project site, available for quality-control comparisons throughout the course of construction activity. Sample sets may be used to determine final acceptance of construction associated with each set.
   a. Samples that may be incorporated into the Work are indicated in individual Specification Sections. Such Samples must be in an undamaged condition at time of use.
   b. Samples not incorporated into the Work, or otherwise designated as Owner's property, are the property of Contractor.
6. Samples for Initial Selection: Submit manufacturer's color charts consisting of units or sections of units showing the full range of colors, textures, and patterns available.
   a. Number of Samples: Submit two full sets of available choices where color, pattern, texture, or similar characteristics are required to be selected from manufacturer's product line. Architect will return submittal with options selected.
7. Samples for Verification: Submit full-size units or Samples of size indicated, prepared from same material to be used for the Work, cured and finished in manner specified, and physically identical with material or product proposed for use, and that show full range of color and texture variations expected. Samples include, but are not limited to, the following: partial sections of manufactured or fabricated components; small cuts or containers of materials; complete units of repetitively used materials; swatches showing color, texture, and pattern; color range sets; and components used for independent testing and inspection.
   a. Number of Samples: Submit two sets of Samples. Architect will retain one Sample set; Architect will. mark up and return a pdf of the submittal to confirm selections.
      1) Submit a single Sample where assembly details, workmanship, fabrication techniques, connections, operation, and other similar characteristics are to be demonstrated.
      2) If variation in color, pattern, texture, or other characteristic is inherent in material or product represented by a Sample, submit two sets of paired units that show approximate limits of variations.

D. Product Schedule: As required in individual Specification Sections, prepare a written summary indicating types of products required for the Work and their intended location. Include the following information in tabular form:

1. Type of product. Include unique identifier for each product indicated in the Contract Documents or assigned by Contractor if none is indicated.
2. Manufacturer and product name, and model number if applicable.
3. Number and name of room or space.

4. Location within room or space.

E. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, contact information of architects and owners, and other information specified.

F. Design Data: Prepare and submit written and graphic information indicating compliance with indicated performance and design criteria in individual Specification Sections. Include list of assumptions and summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Number each page of submittal.

G. Certificates:

1. Certificates and Certifications Submittals: Submit a statement that includes signature of entity responsible for preparing certification. Certificates and certifications shall be signed by an officer or other individual authorized to sign documents on behalf of that entity. Provide a notarized signature where indicated.
2. Installer Certificates: Submit written statements on manufacturer's letterhead certifying that Installer complies with requirements in the Contract Documents and, where required, is authorized by manufacturer for this specific Project.
3. Manufacturer Certificates: Submit written statements on manufacturer's letterhead certifying that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.
4. Material Certificates: Submit written statements on manufacturer's letterhead certifying that material complies with requirements in the Contract Documents.
5. Product Certificates: Submit written statements on manufacturer's letterhead certifying that product complies with requirements in the Contract Documents.
6. Welding Certificates: Prepare written certification that welding procedures and personnel comply with requirements in the Contract Documents. Submit record of Welding Procedure Specification and Procedure Qualification Record on AWS forms. Include names of firms and personnel certified.

H. Test and Research Reports:

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

b. Date of evaluation.
c. Time period when report is in effect.
d. Product and manufacturers' names.
e. Description of product.
f. Test procedures and results.
g. Limitations of use.

1.7 DELEGATED-DESIGN SERVICES

A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.

1. If criteria indicated are insufficient to perform services or certification required, submit a written request for additional information to Architect.

B. Delegated-Design Services Certification: In addition to Shop Drawings, Product Data, and other required submittals, submit digitally signed PDF file paper copies of certificate, signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional.

1. Indicate that products and systems comply with performance and design criteria in the Contract Documents. Include list of codes, loads, and other factors used in performing these services.

1.8 CONTRACTOR'S REVIEW

A. Action Submittals and Informational Submittals: Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to Architect.

B. Contractor's Approval: Indicate Contractor's approval for each submittal with a uniform approval stamp. Include name of reviewer, date of Contractor's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.

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

1.9 ARCHITECT'S REVIEW

A. Submittals: Architect will review each submittal and indicate corrections or revisions required.

1. PDF Submittals: Architect will indicate, via markup on each submittal, the appropriate action, as follows:

B. Informational Submittals: Architect will review each submittal and will not return it, or will return it if it does not comply with requirements. Architect will forward each submittal to appropriate party.

C. Partial submittals prepared for a portion of the Work will be reviewed when use of partial submittals has received prior approval from Architect.

D. Incomplete submittals are unacceptable, will be considered nonresponsive, and will be returned for resubmittal without review.

E. Architect will return without review submittals received from sources other than Contractor.

F. Submittals not required by the Contract Documents will be returned by Architect without action.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 013300

SECTION 014000 - QUALITY REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for quality assurance and quality control.

B. Testing and inspection services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements.

1. Specific quality-assurance and quality-control requirements for individual work results are specified in their respective Specification Sections. Requirements in individual Sections may also cover production of standard products.
2. Specified tests, inspections, and related actions do not limit Contractor's other quality-assurance and quality-control procedures that facilitate compliance with the Contract Document requirements.
3. Requirements for Contractor to provide quality-assurance and quality-control services required by Architect, Owner, or authorities having jurisdiction are not limited by provisions of this Section.
4. Specific test and inspection requirements are not specified in this Section.

C. Related Requirements:

1. Section 013200 “Construction Progress Documentation” for developing a schedule of required tests and inspections.

1.2 DEFINITIONS

A. Experienced: When used with an entity or individual, "experienced" unless otherwise further described means having successfully completed a minimum of five previous projects similar in nature, size, and extent to this Project; being familiar with special requirements indicated; and having complied with requirements of authorities having jurisdiction.

B. Field Quality-Control Tests: Tests and inspections that are performed on-site for installation of the Work and for completed Work.

C. Installer/Applicator/Erector: Contractor or another entity engaged by Contractor as an employee, Subcontractor, or Sub-subcontractor, to perform a particular construction operation, including installation, erection, application, assembly, and similar operations.

1. Use of trade-specific terminology in referring to a trade or entity does not require that certain construction activities be performed by accredited or unionized individuals, or that requirements specified apply exclusively to specific trade(s).

D. Mockups: Full-size physical assemblies that are constructed on-site either as freestanding temporary built elements or as part of permanent construction. Mockups are constructed to verify selections made under Sample submittals; to demonstrate aesthetic effects and qualities of materials and execution; to review coordination, testing, or operation; to show interface between dissimilar materials; and to demonstrate compliance with specified installation tolerances. Mockups are not Samples. Unless otherwise indicated, approved mockups establish the standard by which the Work will be judged.

1. Laboratory Mockups: Full-size physical assemblies constructed and tested at testing facility to verify performance characteristics.
2. Integrated Exterior Mockups: Mockups of the exterior envelope constructed on-site as freestanding temporary built elements or as part of permanent construction, consisting of multiple products, assemblies, and subassemblies.

E. Preconstruction Testing: Tests and inspections performed specifically for Project before products and materials are incorporated into the Work, to verify performance or compliance with specified criteria.

F. Product Tests: Tests and inspections that are performed by a nationally recognized testing laboratory (NRTL) according to 29 CFR 1910.7, by a testing agency accredited according to NIST's National Voluntary Laboratory Accreditation Program (NVLAP), or by a testing agency qualified to conduct product testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with specified requirements.

G. Source Quality-Control Tests: Tests and inspections that are performed at the source; for example, plant, mill, factory, or shop.

H. Testing Agency: An entity engaged to perform specific tests, inspections, or both. Testing laboratory shall mean the same as testing agency.

I. Quality-Assurance Services: Activities, actions, and procedures performed before and during execution of the Work to guard against defects and deficiencies and substantiate that proposed construction will comply with requirements.

J. Quality-Control Services: Tests, inspections, procedures, and related actions during and after execution of the Work to evaluate that actual products incorporated into the Work and completed construction comply with requirements. Contractor's quality-control services do not include contract administration activities performed by Architect.

1.3 DELEGATED-DESIGN SERVICES

A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.

1. If criteria indicated are not sufficient to perform services or certification required, submit a written request for additional information to Architect.

1.4 CONFLICTING REQUIREMENTS

A. Conflicting Standards and Other Requirements: If compliance with two or more standards or requirements are specified and the standards or requirements establish different or conflicting requirements for minimum quantities or quality levels, comply with the most stringent requirement. Refer conflicting requirements that are different, but apparently equal, to Architect for direction before proceeding.

B. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified shall be the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of requirements. Refer uncertainties to Architect for a decision before proceeding.

1.5 ACTION SUBMITTALS

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

1.6 INFORMATIONAL SUBMITTALS

A. Contractor's Quality-Control Plan: For quality-assurance and quality-control activities and responsibilities.

B. Qualification Data: For Contractor's quality-control personnel.

C. Testing Agency Qualifications: For testing agencies specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include proof of qualifications in the form of a recent report on the inspection of the testing agency by a recognized authority.

D. Schedule of Tests and Inspections: Prepare in tabular form and include the following:

1. Specification Section number and title.
2. Entity responsible for performing tests and inspections.
3. Description of test and inspection.
4. Identification of applicable standards.
5. Identification of test and inspection methods.
6. Number of tests and inspections required.
7. Time schedule or time span for tests and inspections.
8. Requirements for obtaining samples.
9. Unique characteristics of each quality-control service.

E. Reports: Prepare and submit certified written reports and documents as specified.

F. Permits, Licenses, and Certificates: For Owner's record, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, correspondence, records, and similar documents established for compliance with standards and regulations bearing on performance of the Work.

1.7 REPORTS AND DOCUMENTS

A. Test and Inspection Reports: Prepare and submit certified written reports specified in other Sections. Include the following:

1. Date of issue.
2. Project title and number.
3. Name, address, telephone number, and email address of testing agency.
4. Dates and locations of samples and tests or inspections.
5. Names of individuals making tests and inspections.
6. Description of the Work and test and inspection method.
7. Identification of product and Specification Section.
8. Complete test or inspection data.
9. Test and inspection results and an interpretation of test results.

10. Record of temperature and weather conditions at time of sample taking and testing and inspection.
11. Comments or professional opinion on whether tested or inspected Work complies with the Contract Document requirements.
12. Name and signature of laboratory inspector.
13. Recommendations on retesting and reinspecting.
14. Test reports shall include a description of deficiencies noted, and corrective action undertaken to resolve such deficiencies.
15. Deficiencies observed shall immediately be brought to the attention of the Contractor's field superintendent, and trade foreman. In the event deficiencies are not corrected, or if an interpretation of the contract documents is required, the Testing Agency shall immediately notify the Architect and applicable engineer.
16. The Testing Agency shall maintain a deficiency list of all items not corrected and shall re-inspect the area after the deficiency has been corrected. The list shall included a description of the deficiency, the date and time the deficiency was observed, who was notified, the date of re-inspection and description of corrective action taken. Distribute the deficiency list at least once per month.

B. Manufacturer's Technical Representative's Field Reports: Prepare written information documenting manufacturer's technical representative's tests and inspections specified in other Sections. Include the following:

1. Name, address, telephone number, and email address of technical representative making report.
2. Statement on condition of substrates and their acceptability for installation of product.
3. Statement that products at Project site comply with requirements.
4. Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.
5. Results of operational and other tests and a statement of whether observed performance complies with requirements.
6. Statement whether conditions, products, and installation will affect warranty.
7. Other required items indicated in individual Specification Sections.

C. Factory-Authorized Service Representative's Reports: Prepare written information documenting manufacturer's factory-authorized service representative's tests and inspections specified in other Sections. Include the following:

1. Name, address, telephone number, and email address of factory-authorized service representative making report.
2. Statement that equipment complies with requirements.
3. Results of operational and other tests and a statement of whether observed performance complies with requirements.
4. Statement whether conditions, products, and installation will affect warranty.
5. Other required items indicated in individual Specification Sections.

1.8 QUALITY ASSURANCE

A. General: Qualifications paragraphs in this article establish the minimum qualification levels required; individual Specification Sections specify additional requirements.

B. Manufacturer Qualifications: A firm experienced in manufacturing products or systems similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units. As applicable, procure products from manufacturers able to meet qualification requirements, warranty requirements, and technical or factory-authorized service representative requirements.

C. Fabricator Qualifications: A firm experienced in producing products similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

D. Installer Qualifications: A firm or individual experienced in installing, erecting, applying, or assembling work similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.

E. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of the system, assembly, or product that are similar in material, design, and extent to those indicated for this Project.

F. Specialists: Certain Specification Sections require that specific construction activities shall be performed by entities who are recognized experts in those operations. Specialists shall satisfy qualification requirements indicated and shall be engaged for the activities indicated.

1. Requirements of authorities having jurisdiction shall supersede requirements for specialists.

G. Testing Agency Qualifications: An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspection indicated, as documented according to ASTM E 329; and with additional qualifications specified in individual Sections; and, where required by authorities having jurisdiction, that is acceptable to authorities.

H. Manufacturer's Technical Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to observe and inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.

I. Factory-Authorized Service Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.

J. Preconstruction Testing: Where testing agency is indicated to perform preconstruction testing for compliance with specified requirements for performance and test methods, comply with the following:

1. Contractor responsibilities include the following:
   a. Provide test specimens representative of proposed products and construction.
   b. Submit specimens in a timely manner with sufficient time for testing and analyzing results to prevent delaying the Work.
   c. Provide sizes and configurations of test assemblies, mockups, and laboratory mockups to adequately demonstrate capability of products to comply with performance requirements.
   d. Build site-assembled test assemblies and mockups using installers who will perform same tasks for Project.
   e. Build laboratory mockups at testing facility using personnel, products, and methods of construction indicated for the completed Work.
   f. When testing is complete, remove test specimens and test assemblies, and mockups; do not reuse products on Project.

2. Testing Agency Responsibilities: Submit a certified written report of each test, inspection, and similar quality-assurance service to Architect, with copy to Contractor. Interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from the Contract Documents.

K. Mockups: Before installing portions of the Work requiring mockups, build mockups for each form of construction and finish required to comply with the following requirements, using materials indicated for the completed Work:

1. Build mockups in location and of size indicated or, if not indicated, as directed by Architect.
2. Notify Architect seven days in advance of dates and times when mockups will be constructed.
3. Employ supervisory personnel who will oversee mockup construction. Employ workers that will be employed to perform same tasks during the construction at Project.
4. Demonstrate the proposed range of aesthetic effects and workmanship.
5. Obtain Architect's approval of mockups before starting corresponding work, fabrication, or construction.
   a. Allow seven days for initial review and each re-review of each mockup.
6. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
7. Demolish and remove mockups when directed unless otherwise indicated.

L. Integrated Exterior Mockups: Construct integrated exterior mockup as indicated on Drawings. Coordinate installation of exterior envelope materials and products for which mockups are required in individual Specification Sections, along with supporting materials. Comply with requirements in "Mockups" Paragraph.

M. Laboratory Mockups: Comply with requirements of preconstruction testing and those specified in individual Specification Sections.

1.9 QUALITY CONTROL

A. Owner Responsibilities: Where quality-control services are indicated as Owner's responsibility, Owner will engage a qualified testing agency to perform these services.

1. Owner will furnish Contractor with names, addresses, and telephone numbers of testing agencies engaged and a description of types of testing and inspection they are engaged to perform.
2. Payment for these services will be made by the Owner.
3. Costs for retesting and reinspecting construction that replaces or is necessitated by work that failed to comply with the Contract Documents will be charged to Contractor, and the Contract Sum will be adjusted by Change Order.

B. Contractor Responsibilities: Tests and inspections not explicitly assigned to Owner are Contractor's responsibility. Perform additional quality-control activities, whether specified or not, to verify and document that the Work complies with requirements.

1. Unless otherwise indicated, provide quality-control services specified and those required by authorities having jurisdiction. Perform quality-control services required of Contractor by authorities having jurisdiction, whether specified or not.
2. Engage a qualified testing agency to perform quality-control services.
   a. Contractor shall not employ same entity engaged by Owner, unless agreed to in writing by Owner.

3. Notify testing agencies at least 24 hours in advance of time when Work that requires testing or inspection will be performed.
4. Where quality-control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality-control service.
5. Testing and inspection requested by Contractor and not required by the Contract Documents are Contractor's responsibility.
6. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.

C. Retesting/Reinspecting: Regardless of whether original tests or inspections were Contractor's responsibility, provide quality-control services, including retesting and reinspecting, for construction that replaced Work that failed to comply with the Contract Documents.

D. Testing Agency Responsibilities: Cooperate with Architect and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.

1. Notify Architect and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
2. Determine the locations from which test samples will be taken and in which in-situ tests are conducted.
3. Conduct and interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from requirements.
4. Submit a certified written report, in duplicate, of each test, inspection, and similar quality-control service through Contractor.
5. Do not release, revoke, alter, or increase the Contract Document requirements or approve or accept any portion of the Work.
6. Do not perform duties of Contractor.

E. Manufacturer's Field Services: Where indicated, engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including service connections. Report results in writing as specified in Section 013300 "Submittal Procedures."

F. Manufacturer's Technical Services: Where indicated, engage a manufacturer's technical representative to observe and inspect the Work. Manufacturer's technical representative's services include participation in preinstallation conferences, examination of substrates and conditions, verification of materials, observation of Installer activities, inspection of completed portions of the Work, and submittal of written reports.

G. Associated Contractor Services: Cooperate with agencies and representatives performing required tests, inspections, and similar quality-control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel. Provide the following:

1. Access to the Work.
2. Incidental labor and facilities necessary to facilitate tests and inspections.
3. Adequate quantities of representative samples of materials that require testing and inspection. Assist agency in obtaining samples.
4. Facilities for storage and field curing of test samples.
5. Delivery of samples to testing agencies.
6. Preliminary design mix proposed for use for material mixes that require control by testing agency.
7. Security and protection for samples and for testing and inspection equipment at Project site.
8. Furnish tools, samples of materials, design mixes, equipment and assistance as requested.

9. Provide and maintain, for the sole use of the Testing Agency, adequate facilities for the safe storage and proper curing of concrete test cylinders on the project site for the first 24 hours after casting as required by ASTM C31, Method of Making and Curing Concrete Test Specimens in the Field.
10. Build and store masonry test prisms in a manner acceptable to the Testing Agency. Prisms to be tested shall remain at the job site until moved by Testing Agency personnel.
11. Notify Testing Agency at least 10 working days in advance of any qualification testing for welding require herein.
12. Notify Testing Agency at least 24 hours prior to expected time for operations requiring testing or inspection services.
13. Make arrangements with the Testing Agency and pay for additional samples and tests made for the Contractor's convenience or for retesting of failed samples.
14. For deficiencies requiring corrective action, submit in writing a description of the deficiency and a proposed correction to the Architect. After review and approval, the proposed corrective action shall be implemented and inspected by the Testing Agency. It is the Contractor's responsibility to ascertain that the deficiency is corrected and inspected prior to the work being covered.
15. Retention of an independent Testing Agency by the Owner shall in no way relieve the Contractor of responsibility for performing all work in accordance with contract requirement.

H. Coordination: Coordinate sequence of activities to accommodate required quality-assurance and quality-control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspection.

1. Schedule times for tests, inspections, obtaining samples, and similar activities.

I. Schedule of Tests and Inspections: Prepare a schedule of tests, inspections, and similar quality-control services required by the Contract Documents. Submit schedule within 30 days of date established for the Notice to Proceed.

1. Distribution: Distribute schedule to Owner, Architect, testing agencies, and each party involved in performance of portions of the Work where tests and inspections are required.

1.10 SPECIAL TESTS AND INSPECTIONS

A. Special Tests and Inspections: Owner will engage a qualified testing agency to conduct special tests and inspections required by authorities having jurisdiction.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 TEST AND INSPECTION LOG

A. Test and Inspection Log: Prepare a record of tests and inspections. Include the following:

1. Date test or inspection was conducted.
2. Description of the Work tested or inspected.
3. Date test or inspection results were transmitted to Architect.
4. Identification of testing agency or special inspector conducting test or inspection.

B. Maintain log at Project site. Post changes and revisions as they occur. Provide access to test and inspection log for Architect's reference during normal working hours.

1. Submit log at Project closeout as part of Project Record Documents.

3.2 REPAIR AND PROTECTION

A. General: On completion of testing, inspection, sample taking, and similar services, repair damaged construction and restore substrates and finishes.

1. Provide materials and comply with installation requirements specified in other Specification Sections or matching existing substrates and finishes. Restore patched areas and extend restoration into adjoining areas with durable seams that are as invisible as possible. Comply with the Contract Document requirements for cutting and patching in Section 017300 "Execution."

B. Protect construction exposed by or for quality-control service activities.

C. Repair and protection are Contractor's responsibility, regardless of the assignment of responsibility for quality-control services.

END OF SECTION 014000

SECTION 014200 - REFERENCES

PART 1 - GENERAL

1.1 DEFINITIONS

A. General: Basic Contract definitions are included in the Conditions of the Contract.

B. "Approved": When used to convey Architect's action on Contractor's submittals, applications, and requests, "approved" is limited to Architect's duties and responsibilities as stated in the Conditions of the Contract.

C. "Directed": A command or instruction by Architect. Other terms including "requested," "authorized," "selected," "required," and "permitted" have the same meaning as "directed."

D. "Indicated": Requirements expressed by graphic representations or in written form on Drawings, in Specifications, and in other Contract Documents. Other terms including "shown," "noted," "scheduled," and "specified" have the same meaning as "indicated."

E. "Regulations": Laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, and rules, conventions, and agreements within the construction industry that control performance of the Work.

F. "Furnish": Supply and deliver to Project site, ready for unloading, unpacking, assembly, installation, and similar operations.

G. "Install": Unload, temporarily store, unpack, assemble, erect, place, anchor, apply, work to dimension, finish, cure, protect, clean, and similar operations at Project site.

H. "Provide": Furnish and install, complete and ready for the intended use.

I. "Project Site": Space available for performing construction activities. The extent of Project site is shown on Drawings and may or may not be identical with the description of the land on which Project is to be built.

1.2 INDUSTRY STANDARDS

A. Applicability of Standards: Unless the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect as if bound or copied directly into the Contract Documents to the extent referenced. Such standards are made a part of the Contract Documents by reference.

B. Publication Dates: Comply with standards in effect as of date of the Contract Documents unless otherwise indicated.

C. Copies of Standards: Each entity engaged in construction on Project should be familiar with industry standards applicable to its construction activity. Copies of applicable standards are not bound with the Contract Documents.

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

1.3 ABBREVIATIONS AND ACRONYMS

A. Industry Organizations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities indicated in Gale's "Encyclopedia of Associations: National Organizations of the U.S." or in Columbia Books' "National Trade & Professional Associations of the United States."

B. Industry Organizations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. This information is subject to change and is believed to be accurate as of the date of the Contract Documents.

1. AABC - Associated Air Balance Council; www.aabc.com.
2. AAMA - American Architectural Manufacturers Association; www.aamanet.org.
3. AAPFCO - Association of American Plant Food Control Officials; www.aapfco.org.
4. AASHTO - American Association of State Highway and Transportation Officials; www.transportation.org.
5. AATCC - American Association of Textile Chemists and Colorists; www.aatcc.org.
6. ABMA - American Bearing Manufacturers Association; www.americanbearings.org.
7. ABMA - American Boiler Manufacturers Association; www.abma.com.
8. ACI - American Concrete Institute; (Formerly: ACI International); www.concrete.org
9. ACPA - American Concrete Pipe Association; www.concrete-pipe.org.
10. AEIC - Association of Edison Illuminating Companies, Inc. (The); www.aeic.org.
11. AF&PA - American Forest & Paper Association; www.afandpa.org.
12. AGA - American Gas Association; www.aga.org.
13. AHAM - Association of Home Appliance Manufacturers; www.aham.org.
14. AHRI - Air-Conditioning, Heating, and Refrigeration Institute (The); www.ahrinet.org.
15. AI - Asphalt Institute; www.asphaltinstitute.org.
16. AIA - American Institute of Architects (The); www.aia.org.
17. AISC - American Institute of Steel Construction; www.aisc.org.
18. AISI - American Iron and Steel Institute; www.steel.org.
19. AITC - American Institute of Timber Construction; www.aitc-glulam.org.
20. AMCA - Air Movement and Control Association International, Inc.; www.amca.org.
21. ANSI - American National Standards Institute; www.ansi.org.
22. AOSA - Association of Official Seed Analysts, Inc.; www.aosaseed.com.
23. APA - APA - The Engineered Wood Association; www.apawood.org.
24. APA - Architectural Precast Association; www.archprecast.org.
25. API - American Petroleum Institute; www.api.org.
26. ARI - Air-Conditioning & Refrigeration Institute; (See AHRI).
27. ARI - American Refrigeration Institute; (See AHRI).
28. ARMA - Asphalt Roofing Manufacturers Association; www.asphaltroofing.org.
29. ASCE - American Society of Civil Engineers; www.asce.org.
30. ASCE/SEI - American Society of Civil Engineers/Structural Engineering Institute; (See ASCE).
31. ASHRAE - American Society of Heating, Refrigerating and Air-Conditioning Engineers; www.ashrae.org.
32. ASME - ASME International; (American Society of Mechanical Engineers); www.asme.org.
33. ASSE - American Society of Safety Engineers (The); www.asse.org.
34. ASSE - American Society of Sanitary Engineering; www.asse-plumbing.org.
35. ASTM - ASTM International; www.astm.org.
36. ATIS - Alliance for Telecommunications Industry Solutions; www.atis.org.
37. AWEA - American Wind Energy Association; www.awea.org.
38. AWI - Architectural Woodwork Institute; www.awinet.org.

39. AWMAC - Architectural Woodwork Manufacturers Association of Canada; www.awmac.com.
40. AWPA - American Wood Protection Association; www.awpa.com.
41. AWS - American Welding Society; www.aws.org.
42. AWWA - American Water Works Association; www.awwa.org.
43. BHMA - Builders Hardware Manufacturers Association; www.buildershardware.com.
44. BIA - Brick Industry Association (The); www.gobrick.com.
45. BICSI - BICSI, Inc.; www.bicsi.org.
46. BIFMA - BIFMA International; (Business and Institutional Furniture Manufacturer's Association); www.bifma.org.
47. BISSC - Baking Industry Sanitation Standards Committee; www.bissc.org.
48. BWF - Badminton World Federation; (Formerly: International Badminton Federation); www.bissc.org.
49. CDA - Copper Development Association; www.copper.org.
50. CE - Conformite Europeenne; http://ec.europa.eu/growth/single-market/ce-marking/
51. CEA - Canadian Electricity Association; www.electricity.ca.
52. CEA - Consumer Electronics Association; www.ce.org.
53. CFFA - Chemical Fabrics and Film Association, Inc.; www.chemicalfabricsandfilm.com.
54. CFSEI - Cold-Formed Steel Engineers Institute; www.cfsei.org.
55. CGA - Compressed Gas Association; www.cganet.com.
56. CIMA - Cellulose Insulation Manufacturers Association; www.cellulose.org.
57. CISCA - Ceilings & Interior Systems Construction Association; www.cisca.org.
58. CISPI - Cast Iron Soil Pipe Institute; www.cispi.org.
59. CLFMI - Chain Link Fence Manufacturers Institute; www.chainlinkinfo.org.
60. CPA - Composite Panel Association; www.pbmdf.com.
61. CRI - Carpet and Rug Institute (The); www.carpet-rug.org.
62. CRRC - Cool Roof Rating Council; www.coolroofs.org.
63. CRSI - Concrete Reinforcing Steel Institute; www.crsi.org.
64. CSA - Canadian Standards Association; www.csa.ca.
65. CSA - CSA International; (Formerly: IAS - International Approval Services); www.csa-international.org.
66. CSI - Construction Specifications Institute (The); www.csinet.org.
67. CSSB - Cedar Shake & Shingle Bureau; www.cedarbureau.org.
68. CTI - Cooling Technology Institute; (Formerly: Cooling Tower Institute); www.cti.org.
69. CWC - Composite Wood Council; (See CPA).
70. DASMA - Door and Access Systems Manufacturers Association; www.dasma.com.
71. DHI - Door and Hardware Institute; www.dhi.org.
72. ECA - Electronic Components Association; (See ECIA).
73. ECAMA - Electronic Components Assemblies & Materials Association; (See ECIA).
74. ECIA - Electronic Components Industry Association; www.eciaonline.org.
75. EIA - Electronic Industries Alliance; (See TIA).
76. EIMA - EIFS Industry Members Association; www.eima.com.
77. EJMA - Expansion Joint Manufacturers Association, Inc.; www.ejma.org.
78. ESD - ESD Association; (Electrostatic Discharge Association); www.esda.org .
79. ESTA - Entertainment Services and Technology Association; (See PLASA).
80. ETL - Intertek (See Intertek); www.intertek.com.
81. EVO - Efficiency Valuation Organization; www.evo-world.org.
82. FCI - Fluid Controls Institute; www.fluidcontrolsinstitute.org.
83. FIBA - Federation Internationale de Basketball; (The International Basketball Federation); www.fiba.com.
84. FIVB - Federation Internationale de Volleyball; (The International Volleyball Federation); www.fivb.org.
85. FM Approvals - FM Approvals LLC; www.fmglobal.com.
86. FM Global - FM Global; (Formerly: FMG - FM Global); www.fmglobal.com.
87. FRSA - Florida Roofing, Sheet Metal & Air Conditioning Contractors Association, Inc.; www.floridaroof.com.

88. FSA - Fluid Sealing Association; www.fluidsealing.com.
89. FSC - Forest Stewardship Council U.S.; www.fscus.org.
90. GA - Gypsum Association; www.gypsum.org.
91. GANA - Glass Association of North America; www.glasswebsite.com.
92. GS - Green Seal; www.greenseal.org.
93. HI - Hydraulic Institute; www.pumps.org.
94. HI/GAMA - Hydronics Institute/Gas Appliance Manufacturers Association; (See AHRI).
95. HMMA - Hollow Metal Manufacturers Association; (See NAAMM).
96. HPVA - Hardwood Plywood & Veneer Association; www.hpva.org.
97. HPW - H. P. White Laboratory, Inc.; www.hpwhite.com.
98. IAPSC - International Association of Professional Security Consultants; www.iapsc.org.
99. IAS - International Accreditation Service; www.iasonline.org.
100. IAS - International Approval Services; (See CSA).
101. ICBO - International Conference of Building Officials; (See ICC).
102. ICC - International Code Council; www.iccsafe.org.
103. ICEA - Insulated Cable Engineers Association, Inc.; www.icea.net.
104. ICPA - International Cast Polymer Alliance; www.icpa-hq.org.
105. ICRI - International Concrete Repair Institute, Inc.; www.icri.org.
106. IEC - International Electrotechnical Commission; www.iec.ch.
107. IEEE - Institute of Electrical and Electronics Engineers, Inc. (The); www.ieee.org.
108. IES - Illuminating Engineering Society; (Formerly: Illuminating Engineering Society of North America); www.ies.org.
109. IESNA - Illuminating Engineering Society of North America; (See IES).
110. IEST - Institute of Environmental Sciences and Technology; www.iest.org.
111. IGMA - Insulating Glass Manufacturers Alliance; www.igmaonline.org.
112. IGSHPA - International Ground Source Heat Pump Association; www.igshpa.okstate.edu.
113. ILI - Indiana Limestone Institute of America, Inc.; www.iliai.com.
114. Intertek - Intertek Group; (Formerly: ETL SEMCO; Intertek Testing Service NA); www.intertek.com.
115. ISA - International Society of Automation (The); (Formerly: Instrumentation, Systems, and Automation Society); www.isa.org.
116. ISAS - Instrumentation, Systems, and Automation Society (The); (See ISA).
117. ISFA - International Surface Fabricators Association; (Formerly: International Solid Surface Fabricators Association); www.isfanow.org.
118. ISO - International Organization for Standardization; www.iso.org.
119. ISSFA - International Solid Surface Fabricators Association; (See ISFA).
120. ITU - International Telecommunication Union; www.itu.int/home.
121. KCMA - Kitchen Cabinet Manufacturers Association; www.kcma.org.
122. LMA - Laminating Materials Association; (See CPA).
123. LPI - Lightning Protection Institute; www.lightning.org.
124. MBMA - Metal Building Manufacturers Association; www.mbma.com.
125. MCA - Metal Construction Association; www.metalconstruction.org.
126. MFMA - Maple Flooring Manufacturers Association, Inc.; www.maplefloor.org.
127. MFMA - Metal Framing Manufacturers Association, Inc.; www.metalframingmfg.org.
128. MHIA - Material Handling Industry of America; www.mhia.org.
129. MIA - Marble Institute of America; www.marble-institute.com.
130. MMPA - Moulding & Millwork Producers Association; www.wmmpa.com.
131. MPI - Master Painters Institute; www.paintinfo.com.
132. MSS - Manufacturers Standardization Society of The Valve and Fittings Industry Inc.; www.mss-hq.org.
133. NAAMM - National Association of Architectural Metal Manufacturers; www.naamm.org.
134. NACE - NACE International; (National Association of Corrosion Engineers International); www.nace.org.
135. NADCA - National Air Duct Cleaners Association; www.nadca.com.
136. NAIMA - North American Insulation Manufacturers Association; www.naima.org.
137. NBGQA - National Building Granite Quarries Association, Inc.; www.nbgqa.com.

138. NBI - New Buildings Institute; www.newbuildings.org.
139. NCAA - National Collegiate Athletic Association (The); www.ncaa.org.
140. NCMA - National Concrete Masonry Association; www.ncma.org.
141. NEBB - National Environmental Balancing Bureau; www.nebb.org.
142. NECA - National Electrical Contractors Association; www.necanet.org.
143. NeLMA - Northeastern Lumber Manufacturers Association; www.nelma.org.
144. NEMA - National Electrical Manufacturers Association; www.nema.org.
145. NETA - InterNational Electrical Testing Association; www.netaworld.org.
146. NFHS - National Federation of State High School Associations; www.nfhs.org.
147. NFPA - National Fire Protection Association; www.nfpa.org.
148. NFPA - NFPA International; (See NFPA).
149. NFRC - National Fenestration Rating Council; www.nfrc.org.
150. NHLA - National Hardwood Lumber Association; www.nhla.com.
151. NLGA - National Lumber Grades Authority; www.nlga.org.
152. NOFMA - National Oak Flooring Manufacturers Association; (See NWFA).
153. NOMMA - National Ornamental & Miscellaneous Metals Association; www.nomma.org.
154. NRCA - National Roofing Contractors Association; www.nrca.net.
155. NRMCA - National Ready Mixed Concrete Association; www.nrmca.org.
156. NSF - NSF International; www.nsf.org.
157. NSPE - National Society of Professional Engineers; www.nspe.org.
158. NSSGA - National Stone, Sand & Gravel Association; www.nssga.org.
159. NTMA - National Terrazzo & Mosaic Association, Inc. (The); www.ntma.com.
160. NWFA - National Wood Flooring Association; www.nwfa.org.
161. PCI - Precast/Prestressed Concrete Institute; www.pci.org.
162. PDI - Plumbing & Drainage Institute; www.pdionline.org.
163. PLASA - PLASA; (Formerly: ESTA - Entertainment Services and Technology Association); http://www.plasa.org.
164. RCSC - Research Council on Structural Connections; www.boltcouncil.org.
165. RFCI - Resilient Floor Covering Institute; www.rfci.com.
166. RIS - Redwood Inspection Service; www.redwoodinspection.com.
167. SAE - SAE International; www.sae.org.
168. SCTE - Society of Cable Telecommunications Engineers; www.scte.org.
169. SDI - Steel Deck Institute; www.sdi.org.
170. SDI - Steel Door Institute; www.steeldoor.org.
171. SEFA - Scientific Equipment and Furniture Association (The); www.sefalabs.com.
172. SEI/ASCE - Structural Engineering Institute/American Society of Civil Engineers; (See ASCE).
173. SIA - Security Industry Association; www.siaonline.org.
174. SJI - Steel Joist Institute; www.steeljoist.org.
175. SMA - Screen Manufacturers Association; www.smainfo.org.
176. SMACNA - Sheet Metal and Air Conditioning Contractors' National Association; www.smacna.org.
177. SMPTE - Society of Motion Picture and Television Engineers; www.smpte.org.
178. SPFA - Spray Polyurethane Foam Alliance; www.sprayfoam.org.
179. SPIB - Southern Pine Inspection Bureau; www.spib.org.
180. SPRI - Single Ply Roofing Industry; www.spri.org.
181. SRCC - Solar Rating & Certification Corporation; www.solar-rating.org.
182. SSINA - Specialty Steel Industry of North America; www.ssina.com.
183. SSPC - SSPC: The Society for Protective Coatings; www.sspc.org.
184. STI - Steel Tank Institute; www.steeltank.com.
185. SWI - Steel Window Institute; www.steelwindows.com.
186. SWPA - Submersible Wastewater Pump Association; www.swpa.org.
187. TCA - Tilt-Up Concrete Association; www.tilt-up.org.
188. TCNA - Tile Council of North America, Inc.; www.tileusa.com.
189. TEMA - Tubular Exchanger Manufacturers Association, Inc.; www.tema.org.

190. TIA - Telecommunications Industry Association (The); (Formerly: TIA/EIA - Telecommunications Industry Association/Electronic Industries Alliance); www.tiaonline.org.
191. TIA/EIA - Telecommunications Industry Association/Electronic Industries Alliance; (See TIA).
192. TMS - The Masonry Society; www.masonrysociety.org.
193. TPI - Truss Plate Institute; www.tpinst.org.
194. TPI - Turfgrass Producers International; www.turfgrasssod.org.
195. TRI - Tile Roofing Institute; www.tileroofing.org.
196. UL - Underwriters Laboratories Inc.; http://www.ul.com.
197. UNI - Uni-Bell PVC Pipe Association; www.uni-bell.org.
198. USAV - USA Volleyball; www.usavolleyball.org.
199. USGBC - U.S. Green Building Council; www.usgbc.org.
200. USITT - United States Institute for Theatre Technology, Inc.; www.usitt.org.
201. WASTEC - Waste Equipment Technology Association; www.wastec.org.
202. WCLIB - West Coast Lumber Inspection Bureau; www.wclib.org.
203. WCMA - Window Covering Manufacturers Association; www.wcmanet.org.
204. WDMA - Window & Door Manufacturers Association; www.wdma.com.
205. WI - Woodwork Institute; www.wicnet.org.
206. WSRCA - Western States Roofing Contractors Association; www.wsrca.com.
207. WWPA - Western Wood Products Association; www.wwpa.org.

C. Code Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. This information is believed to be accurate as of the date of the Contract Documents.

1. DIN - Deutsches Institut fur Normung e.V.; www.din.de.
2. IAPMO - International Association of Plumbing and Mechanical Officials; www.iapmo.org.
3. ICC - International Code Council; www.iccsafe.org.
4. ICC-ES - ICC Evaluation Service, LLC; www.icc-es.org.

D. Federal Government Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. Information is subject to change and is up to date as of the date of the Contract Documents.

1. COE - Army Corps of Engineers; www.usace.army.mil.
2. CPSC - Consumer Product Safety Commission; www.cpsc.gov.
3. DOC - Department of Commerce; National Institute of Standards and Technology; www.nist.gov.
4. DOD - Department of Defense; www.quicksearch.dla.mil.
5. DOE - Department of Energy; www.energy.gov.
6. EPA - Environmental Protection Agency; www.epa.gov.
7. FAA - Federal Aviation Administration; www.faa.gov.
8. FG - Federal Government Publications; www.gpo.gov/fdsys.
9. GSA - General Services Administration; www.gsa.gov.
10. HUD - Department of Housing and Urban Development; www.hud.gov.
11. LBL - Lawrence Berkeley National Laboratory; Environmental Energy Technologies Division; www.eetd.lbl.gov.
12. OSHA - Occupational Safety & Health Administration; www.osha.gov.
13. SD - Department of State; www.state.gov.
14. TRB - Transportation Research Board; National Cooperative Highway Research Program; The National Academies; www.trb.org.
15. USDA - Department of Agriculture; Agriculture Research Service; U.S. Salinity Laboratory; www.ars.usda.gov.
16. USDA - Department of Agriculture; Rural Utilities Service; www.usda.gov.

17. USDOJ - Department of Justice; Office of Justice Programs; National Institute of Justice; www.ojp.usdoj.gov.
18. USP - U.S. Pharmacopeial Convention; www.usp.org.
19. USPS - United States Postal Service; www.usps.com.

E. Standards and Regulations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the standards and regulations in the following list. This information is subject to change and is believed to be accurate as of the date of the Contract Documents.

1. CFR - Code of Federal Regulations; Available from Government Printing Office; www.gpo.gov/fdsys.
2. DOD - Department of Defense; Military Specifications and Standards; Available from DLA Document Services; www.quicksearch.dla.mil.
3. DSCC - Defense Supply Center Columbus; (See FS).
4. FED-STD - Federal Standard; (See FS).
5. FS - Federal Specification; Available from DLA Document Services; www.quicksearch.dla.mil.
   a. Available from Defense Standardization Program; www.dsp.dla.mil.
   b. Available from General Services Administration; www.gsa.gov.
   c. Available from National Institute of Building Sciences/Whole Building Design Guide; www.wbdg.org/ccb.
6. MILSPEC - Military Specification and Standards; (See DOD).
7. USAB - United States Access Board; www.access-board.gov.
8. USATBCB - U.S. Architectural & Transportation Barriers Compliance Board; (See USAB).

F. State Government Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. This information is subject to change and is believed to be accurate as of the date of the Contract Documents.

1. CBHF; State of California; Department of Consumer Affairs; Bureau of Electronic and Appliance Repair, Home Furnishings and Thermal Insulation; www.bearhfti.ca.gov.
2. CCR; California Code of Regulations; Office of Administrative Law; California Title 24 Energy Code; www.calregs.com.
3. CDHS; California Department of Health Services; (See CDPH).
4. CDPH; California Department of Public Health; Indoor Air Quality Program; www.cal-iaq.org.
5. CPUC; California Public Utilities Commission; www.cpuc.ca.gov.
6. SCAQMD; South Coast Air Quality Management District; www.aqmd.gov.
7. TFS; Texas A&M Forest Service; Sustainable Forestry and Economic Development; www.txforestservice.tamu.edu.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 014200

SECTION 015000 - TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.1 SUMMARY

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

B. Related Requirements:

1. Section 011000 "Summary" for work restrictions and limitations on utility interruptions.

1.2 USE CHARGES

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

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

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

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

E. Telecommunications Service: Pay telecommunications service use charges for telecommunications sevices to field office. Telecommunications services shall include:

1. Windows-based personal computer with necessary software, printer, and scanner.
2. Telephone Land Lines: One line, minimum, with handset.
3. Internet Connection: DSL modem or faster.
4. Email access.
5. Cell Phone.

1.3 QUALITY ASSURANCE

A. Electric Service: Comply with NECA, NEMA, and UL standards and regulations for temporary electric service. Install service to comply with NFPA 70.

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

1.4 PROJECT CONDITIONS

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

PART 2 - PRODUCTS

2.1 TEMPORARY FACILITIES

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

B. Common-Use Field Office: Of sufficient size to accommodate needs of Owner, Architect, and construction personnel office activities and to accommodate Project meetings specified in other Division 01 Sections. Keep office clean and orderly.

C. Storage and Fabrication Sheds: Provide sheds sized, furnished, and equipped to accommodate materials and equipment for construction operations.

1. Store combustible materials apart from building.

2.2 EQUIPMENT

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

B. Heating Equipment: Provide vented, self-contained, liquid-propane-gas or fuel-oil heaters with individual space thermostatic control.

1. Use of gasoline-burning space heaters, open-flame heaters, or salamander-type heating units is prohibited.
2. Heating Units: Listed and labeled for type of fuel being consumed, by a qualified testing agency acceptable to authorities having jurisdiction, and marked for intended location and application.

PART 3 - EXECUTION

3.1 TEMPORARY FACILITIES, GENERAL

A. Conservation: Coordinate construction and use of temporary facilities with consideration given to conservation of energy, water, and materials. Coordinate use of temporary utilities to minimize waste.

1. Salvage materials and equipment involved in performance of, but not actually incorporated into, the Work. See other Sections for disposition of salvaged materials that are designated as Owner's property.

3.2 INSTALLATION, GENERAL

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

1. Locate facilities to limit site disturbance as specified in Section 011000 "Summary."

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

3.3 TEMPORARY UTILITY INSTALLATION

A. General: Install temporary service or connect to existing service.

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

B. Sewers and Drainage: Provide temporary utilities to remove effluent lawfully and in accordance with authorities having jurisdiction.

C. Water Service: Install water service and distribution piping in sizes and pressures adequate for construction.

D. Sanitary Facilities: Provide temporary toilets, wash facilities, and drinking water for use of construction personnel. Comply with requirements of authorities having jurisdiction for type, number, location, operation, and maintenance of fixtures and facilities.

E. Temporary Heating and Cooling: Provide temporary heating and cooling required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of low temperatures or high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed.

1. Provide temporary dehumidification systems when required to reduce ambient and substrate moisture levels to level required to allow installation or application of finishes and their proper curing or drying.

F. Electric Power Service: Provide electric power service and distribution system of sufficient size, capacity, and power characteristics required for construction operations.

G. Lighting: Provide temporary lighting with local switching that provides adequate illumination for construction operations, observations, inspections, and traffic conditions.

1. Install and operate temporary lighting that fulfills security and protection requirements without operating entire system.

H. Telephone Service: Provide temporary telephone service in common-use facilities for use by all construction personnel. Install WiFi cell phone access equipment and land-based telephone line(s) for each field office.

1. At each telephone, post a list of important telephone numbers.

I. Electronic Communication Service: Provide internet access adequate for use by Architect and Owner to access Project electronic documents and maintain electronic communications.

3.4 SUPPORT FACILITIES INSTALLATION

A. General: Comply with the following:

1. Provide construction for temporary offices, shops, and sheds located within construction area or within 30 feet of building lines that is noncombustible according to ASTM E 136. Comply with NFPA 241.
2. Maintain support facilities until Architect schedules Substantial Completion inspection. Remove before Substantial Completion. Personnel remaining after Substantial Completion will be permitted to use permanent facilities, under conditions acceptable to Owner.

B. Temporary Roads and Paved Areas: Construct and maintain temporary roads and paved areas adequate for construction operations. Locate temporary roads and paved areas within construction limits indicated on Drawings.

1. Provide dust-control treatment that is nonpolluting and nontracking. Reapply treatment as required to minimize dust.

C. Traffic Controls: Comply with requirements of authorities having jurisdiction.

1. Protect existing site improvements to remain including curbs, pavement, and utilities.
2. Maintain access for fire-fighting equipment and access to fire hydrants.

D. Parking: Arrange for temporary parking areas for construction personnel.

E. Dewatering Facilities and Drains: Comply with requirements of authorities having jurisdiction. Maintain Project site, excavations, and construction free of water.

1. Dispose of rainwater in a lawful manner that will not result in flooding Project or adjoining properties or endanger permanent Work or temporary facilities.
2. Remove snow and ice as required to minimize accumulations.

F. Project Signs: Provide Project signs as indicated. Unauthorized signs are not permitted.

1. Identification Signs: Provide Project identification signs as indicated on Drawings.
2. Temporary Signs: Provide other signs as indicated and as required to inform public and individuals seeking entrance to Project.
   a. Provide temporary, directional signs for construction personnel and visitors.
3. Maintain and touch up signs so they are legible at all times.

G. Waste Disposal Facilities: Provide waste-collection containers in sizes adequate to handle waste from construction operations. Comply with requirements of authorities having jurisdiction. Comply with progress cleaning requirements in Section 017300 "Execution."

1. Provide waste removal facilities and services as required to maintain the site in clean and orderly condition.
2. Provide containers with lids. Remove trash from site periodically.
3. If materials to be recycled or re-used on the project must be stored on-site, provide suitable non-combustible containers; locate containers holding flammable material outside the structure unless otherwise approved by the authorities having jurisdiction.
4. Open free-fall chutes are not permitted. Terminate closed chutes into appropriate containers with lids.

H. Lifts and Hoists: Provide facilities necessary for hoisting materials and personnel.

1. Truck cranes and similar devices used for hoisting materials are considered "tools and equipment" and not temporary facilities.

3.5 SECURITY AND PROTECTION FACILITIES INSTALLATION

A. Protection of Existing Facilities: Protect existing vegetation, equipment, structures, utilities, and other improvements at Project site and on adjacent properties, except those indicated to be removed or altered. Repair damage to existing facilities.

1. Where access to adjacent properties is required in order to affect protection of existing facilities, obtain written permission from adjacent property owner to access property for that purpose.

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

C. Temporary Erosion and Sedimentation Control: Provide measures to prevent soil erosion and discharge of soil-bearing water runoff and airborne dust to undisturbed areas and to adjacent properties and walkways, according to erosion- and sedimentation-control Drawings.

1. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross tree- or plant-protection zones.
2. Inspect, repair, and maintain erosion- and sedimentation-control measures during construction until permanent vegetation has been established.
3. Clean, repair, and restore adjoining properties and roads affected by erosion and sedimentation from Project site during the course of Project.
4. Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.

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

E. Tree and Plant Protection: Install temporary fencing located as indicated or outside the drip line of trees to protect vegetation from damage from construction operations. Protect tree root systems from damage, flooding, and erosion.

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

G. Site Enclosure Fence: Before construction operations begin, furnish and install site enclosure fence in a manner that will prevent people from easily entering site except by entrance gates.

1. Extent of Fence: As required to enclose entire Project site or portion determined sufficient to accommodate construction operations.

H. Security Enclosure and Lockup: Provide lockable entrances to prevent unauthorized entrance, vandalism, theft, and similar violations of security. Lock entrances at end of each workday.

I. Barricades, Warning Signs, and Lights: Comply with requirements of authorities having jurisdiction for erecting structurally adequate barricades, including warning signs and lighting.

J. Temporary Egress: Maintain temporary egress from existing occupied facilities as indicated and as required by authorities having jurisdiction.

K. Temporary Enclosures: Provide temporary enclosures for protection of construction, in progress and completed, from exposure, foul weather, other construction operations, and similar activities. Provide temporary weathertight enclosure for building exterior.

L. Temporary Fire Protection: Install and maintain temporary fire-protection facilities of types needed to protect against reasonably predictable and controllable fire losses. Comply with NFPA 241; manage fire-prevention program.

1. Prohibit smoking in construction areas. Comply with additional limits on smoking specified in other Sections.

2. Supervise welding operations, combustion-type temporary heating units, and similar sources of fire ignition according to requirements of authorities having jurisdiction.
3. Develop and supervise an overall fire-prevention and -protection program for personnel at Project site. Review needs with local fire department and establish procedures to be followed. Instruct personnel in methods and procedures. Post warnings and information.
4. Provide fire extinguishers of type and size required by authorities having jurisdiction.

3.6 MOISTURE AND MOLD CONTROL

A. Exposed Construction Period: Before installation of weather barriers, when materials are subject to wetting and exposure and to airborne mold spores, protect as follows:

1. Protect porous materials from water damage.
2. Protect stored and installed material from flowing or standing water.
3. Keep porous and organic materials from coming into prolonged contact with concrete.
4. Remove standing water from decks.
5. Keep deck openings covered or dammed.

B. Partially Enclosed Construction Period: After installation of weather barriers but before full enclosure and conditioning of building, when installed materials are still subject to infiltration of moisture and ambient mold spores, protect as follows:

1. Do not load or install drywall or other porous materials or components, or items with high organic content, into partially enclosed building.
2. Keep interior spaces reasonably clean and protected from water damage.
3. Periodically collect and remove waste containing cellulose or other organic matter.
4. Discard or replace water-damaged material.
5. Do not install material that is wet.
6. Discard and replace stored or installed material that begins to grow mold.
7. Perform work in a sequence that allows wet materials adequate time to dry before enclosing the material in gypsum board or other interior finishes.

C. Controlled Construction Period: After completing and sealing of the building enclosure but prior to the full operation of permanent HVAC systems, maintain as follows:

1. Control moisture and humidity inside building by maintaining effective dry-in conditions.
2. Use temporary or permanent HVAC system to control humidity within ranges specified for installed and stored materials.
3. Comply with manufacturer's written instructions for temperature, relative humidity, and exposure to water limits.
    a. Hygroscopic materials that may support mold growth, including wood and gypsum-based products, that become wet during the course of construction and remain wet for 48 hours are considered defective and require replacing.
    b. Measure moisture content of materials that have been exposed to moisture during construction operations or after installation. Record readings beginning at time of exposure and continuing daily for 48 hours. Identify materials containing moisture levels higher than allowed. Report findings in writing to Architect.
    c. Remove and replace materials that cannot be completely restored to their manufactured moisture level within 48 hours.

3.7 OPERATION, TERMINATION, AND REMOVAL

A. Maintenance: Maintain facilities in good operating condition until removal.

1. Maintain operation of temporary enclosures, heating, cooling, humidity control, ventilation, and similar facilities on a 24-hour basis where required to achieve indicated results and to avoid possibility of damage.

B. Temporary Facility Changeover: Do not change over from using temporary security and protection facilities to permanent facilities until Substantial Completion.

C. Termination and Removal: Remove each temporary facility when need for its service has ended, when it has been replaced by authorized use of a permanent facility, or no later than Substantial Completion. Complete or, if necessary, restore permanent construction that may have been delayed because of interference with temporary facility. Repair damaged Work, clean exposed surfaces, and replace construction that cannot be satisfactorily repaired.

1. Materials and facilities that constitute temporary facilities are property of Contractor. Owner reserves right to take possession of Project identification signs.
2. At Substantial Completion, repair, renovate, and clean permanent facilities used during construction period. Comply with final cleaning requirements specified in Section 017700 "Closeout Procedures."

END OF SECTION 015000

SECTION 016000 - PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for selection of products for use in Project; product delivery, storage, and handling; manufacturers' standard warranties on products; special warranties; and comparable products.

B. Related Requirements:

1. Section 012500 "Substitution Procedures" for requests for substitutions.
2. Section 014200 "References" for applicable industry standards for products specified.

1.2 DEFINITIONS

A. Products: Items obtained for incorporating into the Work, whether purchased for Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.

1. Named Products: Items identified by manufacturer's product name, including make or model number or other designation shown or listed in manufacturer's published product literature that is current as of date of the Contract Documents.
2. New Products: Items that have not previously been incorporated into another project or facility. Products salvaged or recycled from other projects are not considered new products.
3. Comparable Product: Product that is demonstrated and approved by Architect through submittal process to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.

B. Basis-of-Design Product Specification: A specification in which a single manufacturer's product is named and accompanied by the words "basis-of-design product," including make or model number or other designation. In addition to the basis-of-design product description, product attributes and characteristics may be listed to establish the significant qualities related to type, function, in-service performance and physical properties, weight, dimension, durability, visual characteristics, and other special features and requirements for purposes of evaluating comparable products of additional manufacturers named in the specification.

C. Subject to Compliance with Requirements: Where the phrase "Subject to compliance with requirements" introduces a product selection procedure in an individual Specification Section, provide products qualified under the specified product procedure. In the event that a named product or product by a named manufacturer does not meet the other requirements of the specifications, select another named product or product from another named manufacturer that does meet the requirements of the specifications. Submit a comparable product request, if applicable.

1.3 ACTION SUBMITTALS

A. Comparable Product Request Submittal: Submit request for consideration of each comparable product. Identify basis-of-design product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.

1. Include data to indicate compliance with the requirements specified in "Comparable Products" Article.
2. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within seven days of receipt of a comparable product request. Architect will notify Contractor of approval or rejection of proposed comparable product request within 15 days of receipt of request, or seven days of receipt of additional information or documentation, whichever is later.
   a. Form of Architect's Approval of Submittal: As specified in Section 013300 "Submittal Procedures."
   b. Use product specified if Architect does not issue a decision on use of a comparable product request within time allocated.

B. Basis-of-Design Product Specification Submittal: Comply with requirements in Section 013300 "Submittal Procedures." Show compliance with requirements.

1.4 QUALITY ASSURANCE

A. Compatibility of Options: If Contractor is given option of selecting between two or more products for use on Project, select product compatible with products previously selected, even if previously selected products were also options.

1. Each contractor is responsible for providing products and construction methods compatible with products and construction methods of other contractors.
2. If a dispute arises between contractors over concurrently selectable but incompatible products, Architect will determine which products shall be used.

B. Identification of Products: Except for required labels and operating data, do not attach or imprint manufacturer or product names or trademarks on exposed surfaces of products or equipment that will be exposed to view in occupied spaces or on the exterior.

1. Labels: Locate required product labels and stamps on a concealed surface, or, where required for observation following installation, on a visually accessible surface that is not conspicuous.
2. Equipment Nameplates: Provide a permanent nameplate on each item of service-connected or power-operated equipment. Locate on a visually accessible but inconspicuous surface. Include information essential for operation, including the following:
   a. Name of product and manufacturer.
   b. Model and serial number.
   c. Capacity.
   d. Speed.
   e. Ratings.
3. See individual identification sections in Divisions 21, 22, 23, and 26 for additional identification requirements.

1.5 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle products using means and methods that will prevent damage, deterioration, and loss, including theft and vandalism. Comply with manufacturer's written instructions.

B. Delivery and Handling:

1. Schedule delivery to minimize long-term storage at Project site and to prevent overcrowding of construction spaces.

2. Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.
3. Deliver products to Project site in an undamaged condition in manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.
4. Inspect products on delivery to determine compliance with the Contract Documents and to determine that products are undamaged and properly protected.

C. Storage:

1. Store products to allow for inspection and measurement of quantity or counting of units.
2. Store materials in a manner that will not endanger Project structure.
3. Store products that are subject to damage by the elements, under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation.
4. Protect foam plastic from exposure to sunlight, except to extent necessary for period of installation and concealment.
5. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
6. Protect stored products from damage and liquids from freezing.
7. Provide a secure location and enclosure at Project site for storage of materials and equipment by Owner's construction forces. Coordinate location with Owner.

1.6 PRODUCT WARRANTIES

A. Warranties specified in other Sections shall be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of obligations under requirements of the Contract Documents.

1. Manufacturer's Warranty: Written warranty furnished by individual manufacturer for a particular product and specifically endorsed by manufacturer to Owner.
2. Special Warranty: Written warranty required by the Contract Documents to provide specific rights for Owner.

B. Special Warranties: Prepare a written document that contains appropriate terms and identification, ready for execution.

1. Manufacturer's Standard Form: Modified to include Project-specific information and properly executed.
2. Specified Form: When specified forms are included with the Specifications, prepare a written document using indicated form properly executed.
3. See other Sections for specific content requirements and particular requirements for submitting special warranties.

C. Submittal Time: Comply with requirements in Section 017700 "Closeout Procedures."

PART 2 - PRODUCTS

2.1 PRODUCT SELECTION PROCEDURES

A. General Product Requirements: Provide products that comply with the Contract Documents, are undamaged and, unless otherwise indicated, are new at time of installation.

1. Provide products complete with accessories, trim, finish, fasteners, and other items needed for a complete installation and indicated use and effect.
2. Standard Products: If available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects.
3. Owner reserves the right to limit selection to products with warranties meeting requirements of the Contract Documents.
4. Where products are accompanied by the term "as selected," Architect will make selection.
5. Descriptive, performance, and reference standard requirements in the Specifications establish salient characteristics of products.
6. Or Equal: For products specified by name and accompanied by the term "or equal," or "or approved equal," or "or approved," comply with requirements in "Comparable Products" Article to obtain approval for use of an unnamed product.
    a. Submit additional documentation required by Architect in order to establish equivalency of proposed products. Evaluation of "or equal" product status is by the Architect, whose determination is final.

B. Product Selection Procedures:

1. Sole Product: Where Specifications name a single manufacturer and product, provide the named product that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
    a. Sole product may be indicated by the phrase: "Subject to compliance with requirements, provide the following: …"

2. Sole Manufacturer/Source: Where Specifications name a single manufacturer or source, provide a product by the named manufacturer or source that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
    a. Sole manufacturer/source may be indicated by the phrase: "Subject to compliance with requirements, provide products by the following: …"

3. Limited List of Products: Where Specifications include a list of names of both manufacturers and products, provide one of the products listed that complies with requirements. Comparable products or substitutions for Contractor's convenience will be considered unloess otherwise indicated.
    a. Limited list of products may be indicated by the phrase: "Subject to compliance with requirements, provide one of the following: …"

4. Non-Limited List of Products: Where Specifications include a list of names of both available manufacturers and products, provide one of the products listed, or an unnamed product, which complies with requirements.
    a. Non-limited list of products is indicated by the phrase: "Subject to compliance with requirements, available products that may be incorporated in the Work include, but are not limited to, the following: …"

5. Limited List of Manufacturers: Where Specifications include a list of manufacturers' names, provide a product by one of the manufacturers listed that complies with requirements. Comparable products or substitutions for Contractor's convenience will be considered unless otherwise indicated.
    a. Limited list of manufacturers is indicated by the phrase: "Subject to compliance with requirements, provide products by one of the following: …"

6. Non-Limited List of Manufacturers: Where Specifications include a list of available manufacturers, provide a product by one of the manufacturers listed, or a product by an unnamed manufacturer, which complies with requirements.

a. Non-limited list of manufacturers is indicated by the phrase: "Subject to compliance with requirements, available manufacturers whose products may be incorporated in the Work include, but are not limited to, the following: …"

7. Basis-of-Design Product: Where Specifications name a product, or refer to a product indicated on Drawings, and include a list of manufacturers, provide the specified or indicated product or a comparable product by one of the other named manufacturers. Drawings and Specifications indicate sizes, profiles, dimensions, and other characteristics that are based on the product named. Comply with requirements in "Comparable Products" Article for consideration of an unnamed product by one of the other named manufacturers.
   a. For approval of products by unnamed manufacturers, comply with requirements in Section 012500 "Substitution Procedures" for substitutions for convenience.

C. Visual Matching Specification: Where Specifications require "match Architect's sample," provide a product that complies with requirements and matches Architect's sample. Architect's decision will be final on whether a proposed product matches.

1. If no product available within specified category matches and complies with other specified requirements, comply with requirements in Section 012500 "Substitution Procedures" for proposal of product.

D. Visual Selection Specification: Where Specifications include the phrase "as selected by Architect from manufacturer's full range" or similar phrase, select a product that complies with requirements. Architect will select color, gloss, pattern, density, or texture from manufacturer's product line that includes both standard and premium items.

2.2 COMPARABLE PRODUCTS

A. Conditions for Consideration of Comparable Products: Architect will consider Contractor's request for comparable product when the following conditions are satisfied. If the following conditions are not satisfied, Architect may return requests without action, except to record noncompliance with these requirements:

1. Evidence that proposed product does not require revisions to the Contract Documents, is consistent with the Contract Documents, will produce the indicated results, and is compatible with other portions of the Work. Detailed comparison of significant qualities of proposed product with those named in the Specifications. Significant product qualities include attributes such as type, function, in-service performance and physical properties, weight, dimension, durability, visual characteristics, and other specific features and requirements.
2. Evidence that proposed product provides specified warranty.
3. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners, if requested.
4. Samples, if requested.

B. Submittal Requirements: Approval by the Architect of Contractor's request for use of comparable product is not intended to satisfy other submittal requirements. Comply with specified submittal requirements.

PART 3 - EXECUTION (Not Used)

END OF SECTION 016000

SECTION 017300 - EXECUTION

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes general administrative and procedural requirements governing execution of the Work including, but not limited to, the following:

1. Construction layout.
2. Field engineering and surveying.
3. Installation of the Work.
4. Cutting and patching.
5. Coordination of Owner-installed products.
6. Progress cleaning.
7. Starting and adjusting.
8. Protection of installed construction.

B. Related Requirements:

1. Section 011000 "Summary" for limits on use of Project site.
2. Section 013300 "Submittal Procedures" for submitting surveys.
3. Section 017700 "Closeout Procedures" for submitting final property survey with Project Record Documents, recording of Owner-accepted deviations from indicated lines and levels, replacing defective work, and final cleaning.

1.2 DEFINITIONS

A. Cutting: Removal of in-place construction necessary to permit installation or performance of subsequent work.

B. Patching: Fitting and repair work required to restore construction to original conditions after installation of subsequent work.

1.3 PREINSTALLATION MEETINGS

A. Cutting and Patching Conference: Conduct conference at Project site.

1. Prior to commencing work requiring cutting and patching, review extent of cutting and patching anticipated and examine procedures for ensuring satisfactory result from cutting and patching work. Require representatives of each entity directly concerned with cutting and patching to attend, including the following:
   a. Contractor's superintendent.
   b. Trade supervisor responsible for cutting operations.
   c. Trade supervisor(s) responsible for patching of each type of substrate.
   d. Mechanical, electrical, and utilities subcontractors' supervisors, to the extent each trade is affecting by cutting and patching operations.

2. Review areas of potential interference and conflict. Coordinate procedures and resolve potential conflicts before proceeding.

1.4 QUALITY ASSURANCE

A. Land Surveyor Qualifications: A professional land surveyor who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing land-surveying services of the kind indicated.

B. Cutting and Patching: Comply with requirements for and limitations on cutting and patching of construction elements.

1. Structural Elements: When cutting and patching structural elements, notify Architect of locations and details of cutting and await directions from Architect before proceeding. Shore, brace, and support structural elements during cutting and patching. Do not cut and patch structural elements in a manner that could change their load-carrying capacity or increase deflection.
2. Operational Elements: Do not cut and patch operating elements and related components in a manner that results in reducing their capacity to perform as intended or that results in increased maintenance or decreased operational life or safety. Operational elements include the following:
   a. Primary operational systems and equipment.
   b. Fire separation assemblies.
   c. Air or smoke barriers.
   d. Fire-suppression systems.
   e. Plumbing piping systems.
   f. Mechanical systems piping and ducts.
   g. Control systems.
   h. Communication systems.
   i. Fire-detection and -alarm systems.
   j. Conveying systems.
   k. Electrical wiring systems.
   l. Operating systems of special construction.
3. Other Construction Elements: Do not cut and patch other construction elements or components in a manner that could change their load-carrying capacity, that results in reducing their capacity to perform as intended, or that results in increased maintenance or decreased operational life or safety. Other construction elements include but are not limited to the following:
   a. Water, moisture, or vapor barriers.
   b. Membranes and flashings.
   c. Exterior curtain-wall construction.
   d. Sprayed fire-resistive material.
   e. Equipment supports.
   f. Piping, ductwork, vessels, and equipment.
   g. Noise- and vibration-control elements and systems.
4. Visual Elements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch exposed construction in a manner that would, in Architect's opinion, reduce the building's aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.

C. Manufacturer's Installation Instructions: Obtain and maintain on-site manufacturer's written recommendations and instructions for installation of products and equipment.

PART 2 - PRODUCTS

2.1 MATERIALS

A. General: Comply with requirements specified in other Sections.

1. For projects requiring compliance with sustainable design and construction practices and procedures, use products for patching that comply with sustainable design requirements.

B. In-Place Materials: Use materials for patching identical to in-place materials. For exposed surfaces, use materials that visually match in-place adjacent surfaces to the fullest extent possible.

1. If identical materials are unavailable or cannot be used, use materials that, when installed, will provide a match acceptable to Architect for the visual and functional performance of in-place materials.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Existing Conditions: The existence and location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning sitework, investigate and verify the existence and location of underground utilities, mechanical and electrical systems, and other construction affecting the Work.

1. Before construction, verify the location and invert elevation at points of connection of sanitary sewer, storm sewer, and water-service piping; underground electrical services; and other utilities.
2. Furnish location data for work related to Project that must be performed by public utilities serving Project site.

B. Examination and Acceptance of Conditions: Before proceeding with each component of the Work, examine substrates, areas, and conditions, with Installer or Applicator present where indicated, for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.

1. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.
2. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.
3. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.

C. Written Report: Where a written report listing conditions detrimental to performance of the Work is required by other Sections, include the following:

1. Description of the Work.
2. List of detrimental conditions, including substrates.
3. List of unacceptable installation tolerances.
4. Recommended corrections.

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

3.2 PREPARATION

A. Existing Utility Information: Furnish information to local utilities that is necessary to adjust, move, or relocate existing utility structures, utility poles, lines, services, or other utility appurtenances located in or affected by construction. Coordinate with authorities having jurisdiction.

B. Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

C. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.

D. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents caused by differing field conditions outside the control of Contractor, submit a request for information to Architect according to requirements in Section 013100 "Project Management and Coordination."

3.3 CONSTRUCTION LAYOUT

A. Verification: Before proceeding to lay out the Work, verify layout information shown on Drawings, in relation to the property survey and existing benchmarks. If discrepancies are discovered, notify Architect promptly.

B. General: Engage a land surveyor to lay out the Work using accepted surveying practices.

1. Establish benchmarks and control points to set lines and levels at each story of construction and elsewhere as needed to locate each element of Project.
2. Establish limits on use of Project site.
3. Establish dimensions within tolerances indicated. Do not scale Drawings to obtain required dimensions.
4. Inform installers of lines and levels to which they must comply.
5. Check the location, level and plumb, of every major element as the Work progresses.
6. Notify Architect when deviations from required lines and levels exceed allowable tolerances.
7. Close site surveys with an error of closure equal to or less than the standard established by authorities having jurisdiction.

C. Site Improvements: Locate and lay out site improvements, including pavements, grading, fill and topsoil placement, utility slopes, and rim and invert elevations.

D. Building Lines and Levels: Locate and lay out control lines and levels for structures, building foundations, column grids, and floor levels, including those required for mechanical and electrical work. Transfer survey markings and elevations for use with control lines and levels. Level foundations and piers from two or more locations.

E. Record Log: Maintain a log of layout control work. Record deviations from required lines and levels. Include beginning and ending dates and times of surveys, weather conditions, name and duty of each survey party member, and types of instruments and tapes used. Make the log available for reference by Architect.

3.4 FIELD ENGINEERING

A. Identification: Owner will identify existing benchmarks, control points, and property corners.

B. Reference Points: Locate existing permanent benchmarks, control points, and similar reference points before beginning the Work. Preserve and protect permanent benchmarks and control points during construction operations.

1. Do not change or relocate existing benchmarks or control points without prior written approval of Architect. Report lost or destroyed permanent benchmarks or control points promptly. Report the need to relocate permanent benchmarks or control points to Architect before proceeding.
2. Replace lost or destroyed permanent benchmarks and control points promptly. Base replacements on the original survey control points.

C. Benchmarks: Establish and maintain a minimum of two permanent benchmarks on Project site, referenced to data established by survey control points. Comply with authorities having jurisdiction for type and size of benchmark.

1. Record benchmark locations, with horizontal and vertical data, on Project Record Documents.
2. Where the actual location or elevation of layout points cannot be marked, provide temporary reference points sufficient to locate the Work.
3. Remove temporary reference points when no longer needed. Restore marked construction to its original condition.

D. Final Property Survey: Engage a land surveyor to prepare a final property survey showing significant features (real property) for Project. Include on the survey a certification, signed by land surveyor, that principal metes, bounds, lines, and levels of Project are accurately positioned as shown on the survey.

1. Show boundary lines, monuments, streets, site improvements and utilities, existing improvements and significant vegetation, adjoining properties, acreage, grade contours, and the distance and bearing from a site corner to a legal point.
2. Recording: At Substantial Completion, have the final property survey recorded by or with authorities having jurisdiction as the official "property survey."

3.5 INSTALLATION

A. General: Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.

1. Make vertical work plumb and make horizontal work level.
2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
3. Conceal pipes, ducts, and wiring in finished areas unless otherwise indicated.
4. Maintain minimum headroom clearance of 96 inchesin occupied spaces and 90 inchesin unoccupied spaces.

B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.

C. Install products at the time and under conditions that will ensure the best possible results. Maintain conditions required for product performance until Substantial Completion.

D. Conduct construction operations so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy.

E. Sequence the Work and allow adequate clearances to accommodate movement of construction items on site and placement in permanent locations.

F. Tools and Equipment: Where possible, select tools or equipment that minimize production of excessive noise levels.

G. Templates: Obtain and distribute to the parties involved templates for work specified to be factory prepared and field installed. Check Shop Drawings of other portions of the Work to confirm that adequate provisions are made for locating and installing products to comply with indicated requirements.

H. Attachment: Provide blocking and attachment plates and anchors and fasteners of adequate size and number to securely anchor each component in place, accurately located and aligned with other portions of the Work. Where size and type of attachments are not indicated, verify size and type required for load conditions.

1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Architect.
2. Allow for building movement, including thermal expansion and contraction.
3. Coordinate installation of anchorages. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

I. Joints: Make joints of uniform width. Where joint locations in exposed work are not indicated, arrange joints for the best visual effect. Fit exposed connections together to form hairline joints.

J. Repair or remove and replace damaged, defective, or nonconforming Work.

1. Comply with Section 017700 "Closeout Procedures" for repairing or removing and replacing defective Work.

3.6 CUTTING AND PATCHING

A. Cutting and Patching, General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.

1. Cut in-place construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.

B. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during installation or cutting and patching operations, by methods and with materials so as not to void existing warranties.

C. Temporary Support: Provide temporary support of work to be cut.

D. Protection: Protect in-place construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.

E. Adjacent Occupied Areas: Where interference with use of adjoining areas or interruption of free passage to adjoining areas is unavoidable, coordinate cutting and patching according to requirements in Section 011000 "Summary."

F. Existing Utility Services and Mechanical/Electrical Systems: Where existing services/systems are required to be removed, relocated, or abandoned, bypass such services/systems before cutting to minimize interruption to occupied areas.

G. Cutting: Cut in-place construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.

1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots neatly to minimum size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
2. Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
3. Concrete and Masonry: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
4. Excavating and Backfilling: Comply with requirements in applicable Sections where required by cutting and patching operations.
5. Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.
6. Proceed with patching after construction operations requiring cutting are complete.

H. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other work. Patch with durable seams that are as invisible as practicable. Provide materials and comply with installation requirements specified in other Sections, where applicable.

1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate physical integrity of installation.
2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will minimize evidence of patching and refinishing.
   a. Clean piping, conduit, and similar features before applying paint or other finishing materials.
   b. Restore damaged pipe covering to its original condition.
3. Floors and Walls: Where walls or partitions that are removed extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish, color, texture, and appearance. Remove in-place floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.
   a. Where patching occurs in a painted surface, prepare substrate and apply primer and intermediate paint coats appropriate for substrate over the patch, and apply final paint coat over entire unbroken surface containing the patch. Provide additional coats until patch blends with adjacent surfaces.
4. Ceilings: Patch, repair, or rehang in-place ceilings as necessary to provide an even-plane surface of uniform appearance.

5. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weathertight condition and ensures thermal and moisture integrity of building enclosure.

I. Cleaning: Clean areas and spaces where cutting and patching are performed. Remove paint, mortar, oils, putty, and similar materials from adjacent finished surfaces.

3.7 OWNER-INSTALLED PRODUCTS

A. Site Access: Provide access to Project site for Owner's construction personnel.

B. Coordination: Coordinate construction and operations of the Work with work performed by Owner's construction personnel.

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

3.8 PROGRESS CLEANING

A. General: Clean Project site and work areas daily, including common areas. Enforce requirements strictly. Dispose of materials lawfully.

1. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.
2. Do not hold waste materials more than seven days during normal weather or three days if the temperature is expected to rise above 80 deg F.
3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.
   a. Use containers intended for holding waste materials of type to be stored.
4. Coordinate progress cleaning for joint-use areas where Contractor and other contractors are working concurrently.

B. Site: Maintain Project site free of waste materials and debris.

C. Work Areas: Clean areas where work is in progress to the level of cleanliness necessary for proper execution of the Work.

1. Remove liquid spills promptly.
2. Where dust would impair proper execution of the Work, broom-clean or vacuum the entire work area, as appropriate.

D. Installed Work: Keep installed work clean. Clean installed surfaces according to written instructions of manufacturer or fabricator of product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning materials that are not hazardous to health or property and that will not damage exposed surfaces.

E. Concealed Spaces: Remove debris from concealed spaces before enclosing the space.

F. Exposed Surfaces in Finished Areas: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.

G. Waste Disposal: Do not bury or burn waste materials on-site. Do not wash waste materials down sewers or into waterways. Comply with waste disposal requirements in Section 015000 "Temporary Facilities and Controls."

H. During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.

I. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.

J. Limiting Exposures: Supervise construction operations to ensure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.

3.9 STARTING AND ADJUSTING

A. Coordinate startup and adjusting of equipment and operating components with Owner’s commissioning services.

B. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.

C. Adjust equipment for proper operation. Adjust operating components for proper operation without binding.

D. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

E. Manufacturer's Field Service: Comply with qualification requirements in Section 014000 "Quality Requirements."

3.10 PROTECTION OF INSTALLED CONSTRUCTION

A. Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial Completion.

B. Protection of Existing Items: Provide protection and ensure that existing items to remain undisturbed by construction are maintained in condition that existed at commencement of the Work.

C. Comply with manufacturer's written instructions for temperature and relative humidity.

END OF SECTION 017300

SECTION 017419 - CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for the following:

1. Recycling nonhazardous construction waste.
2. Disposing of nonhazardous construction waste.

1.2 DEFINITIONS

A. Construction Waste: Building and site improvement materials and other solid waste resulting from construction, remodeling, renovation, or repair operations. Construction waste includes packaging.

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

C. Recycle: Recovery of construction waste for subsequent processing in preparation for reuse.

D. Salvage and Reuse: Recovery of construction waste and subsequent incorporation into the Work.

1.3 INFORMATIONAL SUBMITTALS

A. Records of Donations: Indicate receipt and acceptance of salvageable waste donated to individuals and organizations. Indicate whether organization is tax exempt.

B. Records of Sales: Indicate receipt and acceptance of salvageable waste sold to individuals and organizations. Indicate whether organization is tax exempt.

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

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

1.4 QUALITY ASSURANCE

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

B. Waste Management Conference: Conduct conference at Project site to comply with requirements in Section 013100 "Project Management and Coordination." Review methods and procedures related to waste management including, but not limited to, the following:

1. Review and discuss waste management plan including responsibilities of waste management coordinator.

2. Review requirements for documenting quantities of each type of waste and its disposition.
3. Review and finalize procedures for materials separation and verify availability of containers and bins needed to avoid delays.
4. Review procedures for periodic waste collection and transportation to recycling and disposal facilities.
5. Review waste management requirements for each trade.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 PLAN IMPLEMENTATION

A. Training: Train workers, subcontractors, and suppliers on proper waste management procedures, as appropriate for the Work.

B. Site Access and Temporary Controls: Conduct waste management operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.

1. Designate and label specific areas on Project site necessary for separating materials that are to be salvaged, recycled, reused, donated, and sold.
2. Comply with Section 015000 "Temporary Facilities and Controls" for controlling dust and dirt, environmental protection, and noise control.

3.2 RECYCLING CONSTRUCTION WASTE, GENERAL

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

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

C. Procedures: Separate recyclable waste from other waste materials, trash, and debris. Separate recyclable waste by type at Project site to the maximum extent practical according to approved construction waste management plan.

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

3.3 RECYCLING CONSTRUCTION WASTE

A. Packaging:

1. Cardboard and Boxes: Break down packaging into flat sheets. Bundle and store in a dry location.
2. Polystyrene Packaging: Separate and bag materials.
3. Pallets: As much as possible, require deliveries using pallets to remove pallets from Project site. For pallets that remain on-site, break down pallets into component wood pieces and comply with requirements for recycling wood.
4. Crates: Break down crates into component wood pieces and comply with requirements for recycling wood.

B. Wood Materials:

1. Clean Cut-Offs of Lumber: Grind or chip into small pieces.
2. Clean Sawdust: Bag sawdust that does not contain painted or treated wood.
   a. Comply with requirements in Section 329300 "Plants" for use of clean sawdust as organic mulch.

C. Gypsum Board: Stack large clean pieces on wood pallets or in container and store in a dry location.

1. Clean Gypsum Board: Grind scraps of clean gypsum board using small mobile chipper or hammer mill. Screen out paper after grinding.

3.4 DISPOSAL OF WASTE

A. General: Except for items or materials to be salvaged, recycled, or otherwise reused, remove waste materials from Project site and legally dispose of them in a landfill or incinerator acceptable to authorities having jurisdiction.

1. Except as otherwise specified, do not allow waste materials that are to be disposed of accumulate on-site.
2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.

B. Burning: Do not burn waste materials.

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

END OF SECTION

SECTION 017700 - CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for contract closeout, including, but not limited to, the following:

1. Substantial Completion procedures.
2. Final completion procedures.
3. Warranties.
4. Final cleaning.
5. Repair of the Work.

B. Related Requirements:

1. Section 017823 "Operation and Maintenance Data" for additional operation and maintenance manual requirements.
2. Section 017839 "Project Record Documents" for submitting Record Drawings, Record Specifications, and Record Product Data.
3. Section 017900 "Demonstration and Training" for requirements to train the Owner's maintenance personnel to adjust, operate, and maintain products, equipment, and systems.

1.2 ACTION SUBMITTALS

A. Contractor's List of Incomplete Items: Initial submittal at Substantial Completion.

B. Certified List of Incomplete Items: Final submittal at final completion.

1.3 CLOSEOUT SUBMITTALS

A. Certificates of Release: From authorities having jurisdiction.

B. Certificate of Insurance: For continuing coverage.

1.4 MAINTENANCE MATERIAL SUBMITTALS

A. Schedule of Maintenance Material Items: For maintenance material submittal items specified in other Sections.

1.5 SUBSTANTIAL COMPLETION PROCEDURES

A. Contractor's List of Incomplete Items: Prepare and submit a list of items to be completed and corrected (Contractor's punch list).

B. Submittals Prior to Substantial Completion: Complete the following prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.

1. Certificates of Release: Obtain and submit releases from authorities having jurisdiction permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
2. Submit closeout submittals specified in other Division 01 Sections, including project record documents, operation and maintenance manuals, damage or settlement surveys, property surveys, and similar final record information.
3. Submit closeout submittals specified in individual Sections, including specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
4. Submit maintenance material submittals specified in individual Sections, including tools, spare parts, extra materials, and similar items, and deliver to location designated by Architect. Label with manufacturer's name and model number.
5. Submit testing, adjusting, and balancing records.
6. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.

C. Procedures Prior to Substantial Completion: Complete the following prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.

1. Advise Owner of pending insurance changeover requirements.
2. Make final changeover of permanent locks and deliver keys to Owner. Advise Owner's personnel of changeover in security provisions.
3. Complete startup and testing of systems and equipment.
4. Perform preventive maintenance on equipment used prior to Substantial Completion.
5. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems. Submit demonstration and training video recordings specified in Section 017900 "Demonstration and Training."
6. Advise Owner of changeover in utility services.
7. Participate with Owner in conducting inspection and walkthrough with local emergency responders.
8. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
9. Complete final cleaning requirements.
10. Touch up paint and otherwise repair and restore marred exposed finishes to eliminate visual defects.

D. Inspection: Submit a written request for inspection to determine Substantial Completion prior to date the Work will be completed and ready for final inspection and tests. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare the Certificate of Substantial Completion after inspection or will notify Contractor of items, either on Contractor's list or additional items identified by Architect, that must be completed or corrected before certificate will be issued.

1. Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.
2. Results of completed inspection will form the basis of requirements for final completion.

1.6 FINAL COMPLETION PROCEDURES

A. Submittals Prior to Final Completion: Before requesting final inspection for determining final completion, complete the following:

1. Submit a final Application for Payment according to Section 012900 "Payment Procedures."

2. Certified List of Incomplete Items: Submit certified copy of Architect's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by Architect. Certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.
3. Certificate of Insurance: Submit evidence of final, continuing insurance coverage complying with insurance requirements.

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

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

1.7 LIST OF INCOMPLETE ITEMS (PUNCH LIST)

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

1. Organize list of spaces in sequential order, starting with exterior areas first.
2. Organize items applying to each space by major element, including categories for ceiling, individual walls, floors, equipment, and building systems.
3. Include the following information at the top of each page:
   a. Project name.
   b. Date.
   c. Name of Architect.
   d. Name of Contractor.
   e. Page number.

1.8 SUBMITTAL OF PROJECT WARRANTIES

A. Time of Submittal: Submit written warranties on request of Architect for designated portions of the Work where warranties are indicated to commence on dates other than date of Substantial Completion, or when delay in submittal of warranties might limit Owner's rights under warranty.

B. Organize warranty documents into an orderly sequence based on the table of contents of Project Manual.

C. Warranty Electronic File: Provide warranties and bonds in PDF format. Assemble complete warranty and bond submittal package into a single electronic PDF file with bookmarks enabling navigation to each item. Provide bookmarked table of contents at beginning of document.

1. Submit on digital media acceptable to Architect.

PART 2 - PRODUCTS

2.1 MATERIALS

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

PART 3 - EXECUTION

3.1 FINAL CLEANING

A. General: Perform final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations.

B. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to condition expected in an average commercial building cleaning and maintenance program. Comply with manufacturer's written instructions.

1. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion for entire Project or for a designated portion of Project:
   a. Clean Project site, yard, and grounds, in areas disturbed by construction activities, including landscape development areas, of rubbish, waste material, litter, and other foreign substances.
   b. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.
   c. Rake grounds that are not planted, mulched, or paved to a smooth, even-textured surface.
   d. Remove tools, construction equipment, machinery, and surplus material from Project site.
   e. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.
   f. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
   g. Sweep concrete floors broom clean in unoccupied spaces.
   h. Vacuum carpet and similar soft surfaces, removing debris and excess nap; clean according to manufacturer's recommendations if visible soil or stains remain.
   i. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Polish mirrors and glass, taking care not to scratch surfaces.
   j. Remove labels that are not permanent.
   k. Wipe surfaces of mechanical and electrical equipment, elevator equipment, and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
   l. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
   m. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
   n. Clean ducts, blowers, and coils if units were operated without filters during construction or that display contamination with particulate matter on inspection.
   o. Clean light fixtures, lamps, globes, and reflectors to function with full efficiency.
   p. Leave Project clean and ready for occupancy.

C. Construction Waste Disposal: Comply with waste disposal requirements in Section 015000 "Temporary Facilities and Controls."

3.2 REPAIR OF THE WORK

A. Complete repair and restoration operations before requesting inspection for determination of Substantial Completion.

B. Repair, or remove and replace, defective construction. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment. Where damaged or worn items cannot be repaired or restored, provide replacements. Remove and replace operating components that cannot be repaired. Restore damaged construction and permanent facilities used during construction to specified condition.

1. Remove and replace chipped, scratched, and broken glass, reflective surfaces, and other damaged transparent materials.
2. Touch up and otherwise repair and restore marred or exposed finishes and surfaces. Replace finishes and surfaces that that already show evidence of repair or restoration.
   a. Do not paint over "UL" and other required labels and identification, including mechanical and electrical nameplates. Remove paint applied to required labels and identification.
3. Replace parts subject to operating conditions during construction that may impede operation or reduce longevity.
4. Replace burned-out bulbs, bulbs noticeably dimmed by hours of use, and defective and noisy starters in fluorescent and mercury vapor fixtures to comply with requirements for new fixtures.

END OF SECTION 017700

SECTION 017823 - OPERATION AND MAINTENANCE DATA

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for preparing operation and maintenance manuals, including the following:

1. Operation and maintenance documentation directory manuals.
2. Emergency manuals.
3. Systems and equipment operation manuals.
4. Systems and equipment maintenance manuals.
5. Product maintenance manuals.

B. Related Requirements:

1. Section 013300 "Submittal Procedures" for submitting copies of submittals for operation and maintenance manuals.

1.2 CLOSEOUT SUBMITTALS

A. Submit operation and maintenance manuals indicated. Provide content for each manual as specified in individual Specification Sections, and as reviewed and approved at the time of Section submittals. Submit reviewed manual content formatted and organized as required by this Section.

1. Architect will comment on whether content of operation and maintenance submittals is acceptable.
2. Where applicable, clarify and update reviewed manual content to correspond to revisions and field conditions.

B. Format: Submit operation and maintenance manuals in the following format:

1. Submit on digital media acceptable to Architect. Enable reviewer comments on draft submittals.

C. Initial Manual Submittal: Submit draft copy of each manual at least 15 days before requesting inspection for Substantial Completion. Architect will comment on whether general scope and content of manual are acceptable.

D. Final Manual Submittal: Submit each manual in final form at least 15 days before final inspection. Architect will return copy with comments within 15 days after final inspection.

1. Correct or revise each manual to comply with Architect's comments. Submit copies of each corrected manual within 10 days of receipt of Architect's comments.

E. Comply with Section 017700 "Closeout Procedures" for schedule for submitting operation and maintenance documentation.

1.3 FORMAT OF OPERATION AND MAINTENANCE MANUALS

A. Manuals, Electronic Files: Submit manuals in the form of a multiple file composite electronic PDF file for each manual type required.

1. Electronic Files: Use electronic files prepared by manufacturer where available. Where scanning of paper documents is required, configure scanned file for minimum readable file size.
2. File Names and Bookmarks: Bookmark individual documents based on file names. Name document files to correspond to system, subsystem, and equipment names used in manual directory and table of contents. Group documents for each system and subsystem into individual composite bookmarked files, then create composite manual, so that resulting bookmarks reflect the system, subsystem, and equipment names in a readily navigated file tree. Configure electronic manual to display bookmark panel on opening file.

1.4 REQUIREMENTS FOR EMERGENCY, OPERATION, AND MAINTENANCE MANUALS

A. Organization of Manuals: Unless otherwise indicated, organize each manual into a separate section for each system and subsystem, and a separate section for each piece of equipment not part of a system. Each manual shall contain the following materials, in the order listed:

1. Title page.
2. Table of contents.
3. Manual contents.

B. Title Page: Include the following information:

1. Subject matter included in manual.
2. Name and address of Project.
3. Name and address of Owner.
4. Date of submittal.
5. Name and contact information for Contractor.
6. Name and contact information for Architect.
7. Name and contact information for Commissioning Authority.
8. Names and contact information for major consultants to the Architect that designed the systems contained in the manuals.
9. Cross-reference to related systems in other operation and maintenance manuals.

C. Table of Contents: List each product included in manual, identified by product name, indexed to the content of the volume, and cross-referenced to Specification Section number in Project Manual.

1. If operation or maintenance documentation requires more than one volume to accommodate data, include comprehensive table of contents for all volumes in each volume of the set.

D. Manual Contents: Organize into sets of manageable size. Arrange contents alphabetically by system, subsystem, and equipment. If possible, assemble instructions for subsystems, equipment, and components of one system into a single binder.

E. Identification: In the documentation directory and in each operation and maintenance manual, identify each system, subsystem, and piece of equipment with same designation used in the Contract Documents. If no designation exists, assign a designation according to ASHRAE Guideline 4, "Preparation of Operating and Maintenance Documentation for Building Systems."

1.5 OPERATION AND MAINTENANCE DOCUMENTATION DIRECTORY MANUAL

A. Operation and Maintenance Documentation Directory: Prepare a separate manual that provides an organized reference to emergency, operation, and maintenance manuals. List items and their location to facilitate ready access to desired information. Include the following:

1. List of Systems and Subsystems: List systems alphabetically. Include references to operation and maintenance manuals that contain information about each system.
2. List of Equipment: List equipment for each system, organized alphabetically by system. For pieces of equipment not part of system, list alphabetically in separate list.
3. Tables of Contents: Include a table of contents for each emergency, operation, and maintenance manual.

1.6 EMERGENCY MANUALS

A. Emergency Manual: Assemble a complete set of emergency information indicating procedures for use by emergency personnel and by Owner's operating personnel for types of emergencies indicated.

B. Content: Organize manual into a separate section for each of the following:

1. Type of emergency.
2. Emergency instructions.
3. Emergency procedures.

C. Type of Emergency: Where applicable for each type of emergency indicated below, include instructions and procedures for each system, subsystem, piece of equipment, and component:

1. Fire.
2. Flood.
3. Gas leak.
4. Water leak.
5. Power failure.
6. Water outage.
7. System, subsystem, or equipment failure.
8. Chemical release or spill.

D. Emergency Instructions: Describe and explain warnings, trouble indications, error messages, and similar codes and signals. Include responsibilities of Owner's operating personnel for notification of Installer, supplier, and manufacturer to maintain warranties.

E. Emergency Procedures: Include the following, as applicable:

1. Instructions on stopping.
2. Shutdown instructions for each type of emergency.
3. Operating instructions for conditions outside normal operating limits.
4. Required sequences for electric or electronic systems.
5. Special operating instructions and procedures.

1.7 SYSTEMS AND EQUIPMENT OPERATION MANUALS

A. Systems and Equipment Operation Manual: Assemble a complete set of data indicating operation of each system, subsystem, and piece of equipment not part of a system. Include information required for daily operation and management, operating standards, and routine and special operating procedures.

1. Engage a factory-authorized service representative to assemble and prepare information for each system, subsystem, and piece of equipment not part of a system.
2. Prepare a separate manual for each system and subsystem, in the form of an instructional manual for use by Owner's operating personnel.

B. Content: In addition to requirements in this Section, include operation data required in individual Specification Sections and the following information:

1. System, subsystem, and equipment descriptions. Use designations for systems and equipment indicated on Contract Documents.
2. Performance and design criteria if Contractor has delegated design responsibility.
3. Operating standards.
4. Operating procedures.
5. Operating logs.
6. Wiring diagrams.
7. Control diagrams.
8. Piped system diagrams.
9. Precautions against improper use.
10. License requirements including inspection and renewal dates.

C. Descriptions: Include the following:

1. Product name and model number. Use designations for products indicated on Contract Documents.
2. Manufacturer's name.
3. Equipment identification with serial number of each component.
4. Equipment function.
5. Operating characteristics.
6. Limiting conditions.
7. Performance curves.
8. Engineering data and tests.
9. Complete nomenclature and number of replacement parts.

D. Operating Procedures: Include the following, as applicable:

1. Startup procedures.
2. Equipment or system break-in procedures.
3. Routine and normal operating instructions.
4. Regulation and control procedures.
5. Instructions on stopping.
6. Normal shutdown instructions.
7. Seasonal and weekend operating instructions.
8. Required sequences for electric or electronic systems.
9. Special operating instructions and procedures.

E. Systems and Equipment Controls: Describe the sequence of operation, and diagram controls as installed.

F. Piped Systems: Diagram piping as installed, and identify color coding where required for identification.

1.8 SYSTEMS AND EQUIPMENT MAINTENANCE MANUALS

A. Systems and Equipment Maintenance Manuals: Assemble a complete set of data indicating maintenance of each system, subsystem, and piece of equipment not part of a system. Include manufacturers' maintenance documentation, preventive maintenance procedures and frequency, repair procedures, wiring and systems diagrams, lists of spare parts, and warranty information.

1. Engage a factory-authorized service representative to assemble and prepare information for each system, subsystem, and piece of equipment not part of a system.
2. Prepare a separate manual for each system and subsystem, in the form of an instructional manual for use by Owner's operating personnel.

B. Content: For each system, subsystem, and piece of equipment not part of a system, include source information, manufacturers' maintenance documentation, maintenance procedures, maintenance and service schedules, spare parts list and source information, maintenance service contracts, and warranties and bonds as described below.

C. Source Information: List each system, subsystem, and piece of equipment included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual and drawing or schedule designation or identifier where applicable.

D. Manufacturers' Maintenance Documentation: Include the following information for each component part or piece of equipment:

1. Standard maintenance instructions and bulletins; include only sheets pertinent to product or component installed. Mark each sheet to identify each product or component incorporated into the Work. If data include more than one item in a tabular format, identify each item using appropriate references from the Contract Documents. Identify data applicable to the Work and delete references to information not applicable.
   a. Prepare supplementary text if manufacturers' standard printed data are not available and where the information is necessary for proper operation and maintenance of equipment or systems.
2. Drawings, diagrams, and instructions required for maintenance, including disassembly and component removal, replacement, and assembly.
3. Identification and nomenclature of parts and components.
4. List of items recommended to be stocked as spare parts.

E. Maintenance Procedures: Include the following information and items that detail essential maintenance procedures:

1. Test and inspection instructions.
2. Troubleshooting guide.
3. Precautions against improper maintenance.
4. Disassembly; component removal, repair, and replacement; and reassembly instructions.
5. Aligning, adjusting, and checking instructions.
6. Demonstration and training video recording, if available.

F. Maintenance and Service Schedules: Include service and lubrication requirements, list of required lubricants for equipment, and separate schedules for preventive and routine maintenance and service with standard time allotment.

1. Scheduled Maintenance and Service: Tabulate actions for daily, weekly, monthly, quarterly, semiannual, and annual frequencies.
2. Maintenance and Service Record: Include manufacturers' forms for recording maintenance.

G. Spare Parts List and Source Information: Include lists of replacement and repair parts, with parts identified and cross-referenced to manufacturers' maintenance documentation and local sources of maintenance materials and related services.

H. Maintenance Service Contracts: Include copies of maintenance agreements with name and telephone number of service agent.

I. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.

1. Include procedures to follow and required notifications for warranty claims.

J. Drawings: Prepare drawings supplementing manufacturers' printed data to illustrate the relationship of component parts of equipment and systems and to illustrate control sequence and flow diagrams. Coordinate these drawings with information contained in record Drawings to ensure correct illustration of completed installation.

1. Do not use original project record documents as part of maintenance manuals.

1.9 PRODUCT MAINTENANCE MANUALS

A. Product Maintenance Manual: Assemble a complete set of maintenance data indicating care and maintenance of each product, material, and finish incorporated into the Work.

B. Content: Organize manual into a separate section for each product, material, and finish. Include source information, product information, maintenance procedures, repair materials and sources, and warranties and bonds, as described below.

C. Source Information: List each product included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual and drawing or schedule designation or identifier where applicable.

D. Product Information: Include the following, as applicable:

1. Product name and model number.
2. Manufacturer's name.
3. Color, pattern, and texture.
4. Material and chemical composition.
5. Reordering information for specially manufactured products.

E. Maintenance Procedures: Include manufacturer's written recommendations and the following:

1. Inspection procedures.
2. Types of cleaning agents to be used and methods of cleaning.
3. List of cleaning agents and methods of cleaning detrimental to product.
4. Schedule for routine cleaning and maintenance.
5. Repair instructions.

F. Repair Materials and Sources: Include lists of materials and local sources of materials and related services.

G. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.

1. Include procedures to follow and required notifications for warranty claims.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 017823

SECTION 017839 - PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for project record documents, including the following:

1. Record Drawings.
2. Record Specifications.
3. Record Product Data.
4. Miscellaneous record submittals.

B. Related Requirements:

1. Section 017700 "Closeout Procedures" for general closeout procedures.
2. Section 017823 "Operation and Maintenance Data" for operation and maintenance manual requirements.

1.2 CLOSEOUT SUBMITTALS

A. Record Drawings: Comply with the following:

1. Number of Copies: Submit copies of record Drawings as follows:
   a. Initial Submittal:
      1) Submit one paper-copy set of marked-up record prints.
      2) Architect will indicate whether general scope of changes, additional information recorded, and quality of drafting are acceptable. Architect will return marked-up record print to Contractor for conversion into digital data files.
   b. Final Submittal:
      1) Submit one paper-copy set of marked-up record prints.
      2) Submit record digital data files of record digital data file plots.
      3) Plot each drawing file, whether or not changes and additional information were recorded.

B. Record Specifications: Submit one paper copy and annotated PDF electronic files of Project's Specifications, including addenda and contract modifications.

C. Record Product Data: Submit annotated PDF electronic files and directories of each submittal.

1. Where record Product Data are required as part of operation and maintenance manuals, submit duplicate marked-up Product Data as a component of manual.

D. Miscellaneous Record Submittals: See other Specification Sections for miscellaneous record-keeping requirements and submittals in connection with various construction activities. Submit annotated PDF electronic files and directories of each submittal.

1.3 RECORD DRAWINGS

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

1. Preparation: Mark record prints to show the actual installation where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to provide information for preparation of corresponding marked-up record prints.
   a. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.
   b. Accurately record information in an acceptable drawing technique.
   c. Record data as soon as possible after obtaining it.
   d. Record and check the markup before enclosing concealed installations.
   e. Cross-reference record prints to corresponding photographic documentation.

2. Content: Types of items requiring marking include, but are not limited to, the following:
   a. Dimensional changes to Drawings.
   b. Revisions to details shown on Drawings.
   c. Depths of foundations.
   d. Locations and depths of underground utilities.
   e. Revisions to routing of piping and conduits.
   f. Revisions to electrical circuitry.
   g. Actual equipment locations.
   h. Duct size and routing.
   i. Locations of concealed internal utilities.
   j. Changes made following Architect's written orders.
   k. Details not on the original Contract Drawings.
   l. Field records for variable and concealed conditions.
   m. Record information on the Work that is shown only schematically.

3. Mark the Contract Drawings and Shop Drawings completely and accurately. Use personnel proficient at recording graphic information in production of marked-up record prints.
4. Mark record sets with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.
5. Mark important additional information that was either shown schematically or omitted from original Drawings.
6. Note Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.

B. Record Digital Data Files: Immediately before inspection for Certificate of Substantial Completion, review marked-up record prints with Architect. When authorized, prepare a full set of corrected digital data files of the Contract Drawings, as follows:

1. Format: Same digital data software program, version, and operating system as the original Contract Drawings.
2. Incorporate changes and additional information previously marked on record prints. Delete, redraw, and add details and notations where applicable.
3. Refer instances of uncertainty to Architect for resolution.
4. Architect will furnish Contractor with one set of digital data files of the Contract Drawings for use in recording information.
   a. See Section 013100 "Project Management and Coordination" for requirements related to use of Architect's digital data files.
   b. Record markups in separate layers or worksets.

C. Format: Identify and date each record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location.

1. Record Prints: Organize record prints into manageable sets. Bind each set with durable paper cover sheets. Include identification on cover sheets.

2. Record Digital Data Files: Organize digital data information into separate electronic files that correspond to each sheet of the Contract Drawings. Name each file with the sheet identification. Include identification in each digital data file.
3. Identification: As follows:
   a. Project name.
   b. Date.
   c. Designation "PROJECT RECORD DRAWINGS."
   d. Name of Architect.
   e. Name of Contractor.

1.4 RECORD SPECIFICATIONS

A. Preparation: Mark Specifications to indicate the actual product installation where installation varies from that indicated in Specifications, addenda, and contract modifications.

1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
2. Mark copy with the proprietary name and model number of products, materials, and equipment furnished, including substitutions and product options selected.
3. Record the name of manufacturer, supplier, Installer, and other information necessary to provide a record of selections made.
4. For each principal product, indicate whether record Product Data has been submitted in operation and maintenance manuals instead of submitted as record Product Data.
5. Note related Change Orders, record Product Data, and record Drawings where applicable.

B. Format: Submit record Specifications as annotated PDF electronic file with comment function enabled.

1.5 RECORD PRODUCT DATA

A. Recording: Maintain one copy of each submittal during the construction period for project record document purposes. Post changes and revisions to project record documents as they occur; do not wait until end of Project.

B. Preparation: Mark Product Data to indicate the actual product installation where installation varies substantially from that indicated in Product Data submittal.

1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
2. Include significant changes in the product delivered to Project site and changes in manufacturer's written instructions for installation.
3. Note related Change Orders, record Specifications, and record Drawings where applicable.

C. Format: Submit record Product Data as annotated PDF electronic file with comment function enabled.

1. Include record Product Data directory organized by Specification Section number and title, electronically linked to each item of record Product Data.

1.6 MISCELLANEOUS RECORD SUBMITTALS

A. Assemble miscellaneous records required by other Specification Sections for miscellaneous record keeping and submittal in connection with actual performance of the Work. Bind or file miscellaneous records and identify each, ready for continued use and reference.

B. Format: Submit miscellaneous record submittals as PDF electronic file.

1. Include miscellaneous record submittals directory organized by Specification Section number and title, electronically linked to each item of miscellaneous record submittals.

1.7 MAINTENANCE OF RECORD DOCUMENTS

A. Maintenance of Record Documents: Store record documents in the field office apart from the Contract Documents used for construction. Do not use project record documents for construction purposes. Maintain record documents in good order and in a clean, dry, legible condition, protected from deterioration and loss. Provide access to project record documents for Architect's reference during normal working hours.

PART 2 - PRODUCTS

PART 3 - EXECUTION

END OF SECTION 017839

SECTION 017900 - DEMONSTRATION AND TRAINING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for instructing Owner's personnel, including the following:

1. Instruction in operation and maintenance of systems, subsystems, and equipment.

B. Training of Owner personnel in operation and maintenance is required for:

1. All software-operated systems.
2. HVAC systems and equipment.
3. Plumbing equipment.
4. Electrical systems and equipment.
5. Conveying systems.
6. Items specified in individual product Sections.

C. Training of Owner personnel in care, cleaning, maintenance, and repair is required for:

1. Roofing, waterproofing, and other weather-exposed or moisture protection products.
2. Finishes, including flooring, wall finishes, ceiling finishes.
3. Fixtures and fittings.
4. Items specified in individual product Sections.

1.2 INFORMATIONAL SUBMITTALS

A. Training Plan: Owner will designate personnel to be trained; tailor training to needs and skill-level of attendees.

1. Submit to Architect for transmittal to Owner.
2. Submit not less than four weeks prior to start of training.
3. Revise and resubmit until acceptable.
4. Provide an overall schedule showing all training sessions.
5. Include at least the following for each training session:
   a. Identification, date, time, and duration.
   b. Description of products and/or systems to be covered.
   c. Name of firm and person conducting training; include qualifications.
   d. Intended audience, such as job description.
   e. Objectives of training and suggested methods of ensuring adequate training.
   f. Methods to be used, such as classroom lecture, live demonstrations, hands-on, etc.
   g. Media to be used, such a slides, hand-outs, etc.
   h. Training equipment required, such as projector, projection screen, etc., to be provided by Contractor.

B. Training Manuals: Provide training manual for each attendee; allow for minimum of two attendees per training session.

1. Include applicable portion of O&M manuals.
2. Include copies of all hand-outs, slides, overheads, video presentations, etc., that are not included in O&M manuals.

1.3 CLOSEOUT SUBMITTALS

A. Training Manuals: Provde one copy of each training manual to be included with operation and maintenance data in accordance with Section 017823 “Operation and Maintenance Data.”

B. Training Reports:

1. Identification of each training session, date, time, and duration.
2. Sign-in sheet showing names and job titles of attendees.
3. List of attendee questions and written answers given, including copies of and references to supporting documentation required for clarification; include answers to questions that could not be answered in original training session.

1.4 QUALITY ASSURANCE

A. Instructor Qualifications: A factory-authorized service representative, complying with requirements in Section 014000 "Quality Requirements," experienced in operation and maintenance procedures and training.

1. Provide as instructors the most qualified trainer of those contractors and/or installers who actually supplied and installed the systems and equipment.
2. Where a single person is not familiar with all aspects, provide specialists with necessary qualifications.

1.5 COORDINATION

A. Coordinate instruction schedule with Owner's operations. Adjust schedule as required to minimize disrupting Owner's operations and to ensure availability of Owner's personnel.

B. Coordinate instructors, including providing notification of dates, times, length of instruction time, and course content.

C. Coordinate content of training sessions with content of approved emergency, operation, and maintenance manuals. Do not submit instruction program until operation and maintenance data have been reviewed and approved by Architect.

1.6 DEMONSTRATION - GENERAL

A. Demonstrations conducted during system start-up do not qualify as demonstrations for the purposes of this section, unless approved in advance by Owner.

B. Demonstration may be combined with Owner personnel training if applicable.

C. Operating Equipment and Systems: Demonstrate operation in all modes, including start-up, shut-down, seasonal changeover, emergency conditions, and troubleshooting, and maintenance procedures, including scheduled and preventive maintenance.

1. Perform demonstrations not less than two weeks prior to Substantial Completion.
2. For equipment or systems requiring seasonal operation, perform demonstration for other season within six months.

D. Non-Operating Products: Demonstrate cleaning, scheduled and preventive maintenance, and repair procedures.

1. Perform demonstrations not less than two weeks prior to Substantial Completion.

1.7 TRAINING - GENERAL

A. Conduct training on-site unless otherwise indicated.

B. Owner will provide classroom and seating at no cost to Contractor.

C. Provide training in minimum two hour segments.

D. Training schedule will be subject to availability of Owner's personnel to be trained; re-schedule training sessions as required by Owner; once schedule has been approved by Owner failure to conduct sessions according to schedule will be cause for Owner to charge Contractor for personnel "show-up" time.

E. Review of Facility Policy on Operation and Maintenance Data: During training discuss:

1. The location of the O&M manuals and procedures for use and preservation; backup copies.
2. Typical contents and organization of all manuals, including explanatory information, system narratives, and product specific information.
3. Typical uses of the O&M manuals.

F. Product- and System-Specific Training:

1. Review the applicable O&M manuals.
2. For systems, provide an overview of system operation, design parameters and constraints, and operational strategies.
3. Review instructions for proper operation in all modes, including start-up, shut-down, seasonal changeover and emergency procedures, and for maintenance, including preventative maintenance.
4. Provide hands-on training on all operational modes possible and preventive maintenance.
5. Emphasize safe and proper operating requirements; discuss relevant health and safety issues and emergency procedures.
6. Discuss common troubleshooting problems and solutions.
7. Discuss any peculiarities of equipment installation or operation.
8. Discuss warranties and guarantees, including procedures necessary to avoid voiding coverage.
9. Review recommended tools and spare parts inventory suggestions of manufacturers.
10. Review spare parts and tools required to be furnished by Contractor.
11. Review spare parts suppliers and sources and procurement procedures.

G. Be prepared to answer questions raised by training attendees; if unable to answer during training session, provide written response within three days.

PART 2 - PRODUCTS

PART 3 - EXECUTION

END OF SECTION 017900

SECTION 02 41 17 - DEMOLITION

PART 1 - GENERAL

1.01 DESCRIPTION

A. This Section specifies the requirements for demolition of facilities and structures.

B. Extent of demolition work is shown on Drawings. Demolition may, but not necessarily, require removal and disposal, off of the Work Site, of the following:

1. Building structures, as indicated on Drawings, except items to be removed by Galveston County prior to start of work.

2. Entrances, drives, parking lots and structures, and adjacent landscape work to limits indicated on Drawings.

3. Building foundations and supporting walls to a uniform depth of 12 inches below lowest foundation elevation.

4. Paving, curbs, gutters, walkways, and related concrete and asphalt.

1.02 SUBMITTALS

A. In accordance with Section 01340 - Shop Drawings, Product Data, Samples, and Record Documents of these Specifications, the following shall be submitted:

1. Proposed methods and operations of building demo to Galveston County for review and approval prior to start of Work. Include required coordination by agencies for shut-off, capping, and continuation of utility services as required. Provide a detailed sequence of demolition and removal work to ensure uninterrupted progress of Galveston County operations.

1.03 QUALITY ASSURANCE/JOB CONDITIONS

A. Reference Standards Applicable to this Section

1. ANSI: American National Standards Institute

a. A10.6 Safety Requirements for Demolition Operations

2. NFPA: National Fire Protection Association.

a. 30: Flammable and Combustible Liquids Code

b. 241: Standard for Safeguarding Building Construction and Demolition Operations.

B. Regulations

Comply with applicable OSHA and EPA regulations and codes and local ordinances.

C. Occupancy

Structures to be demolished will be discontinued in use prior to start of Work.

D. Condition of Structures and Work Site

Contractor assumes no responsibility for actual condition of structures to be demolished. Conditions existing at time of inspection for bidding purposes will be maintained by Galveston County insofar as practicable. However, variations within structure and Work Site may occur prior to start of demolition work.

E. Partial Removal

Items of value to Contractor may be removed, as directed, as Work progresses. Salvaged items shall become the property of the Contractor and shall be transported from Site as they are removed. Storage or sale of removed items on-Site will not be permitted.

F. Explosives

Use of explosives will not be permitted.

G. Traffic

Contractor shall comply with Section 01570 - Traffic Regulation of these Specifications. Conduct demolition operations and removal of debris to ensure minimum interference with Galveston County operations, roads, streets, walks, and adjacent facilities. Do not close or obstruct streets, walks or other facilities without written permission from authorities having jurisdiction. Provide and identify alternate routes around closed or obstructed traffic ways as required by governing regulations.

H. Protection

Contractor shall comply with Section 01510 - Temporary Facilities of these Specifications. Ensure safe passage of persons around area of demolition. Conduct operations to prevent injury to persons and adjacent buildings, structures, and facilities. Erect temporary covered passageways as required by authorities having jurisdiction. Provide interior and exterior shoring, bracing, or support to prevent movement, settlement or collapse of structures to be demolished and adjacent facilities to remain.

I. Damages

Promptly repair damages caused by demolition operations at no cost to Galveston County or adjacent property owners.

J. Utility Services

Contractor shall comply with Section 01541 - Maintenance and Protection of Utilities of these Specifications. Maintain existing utilities indicated to remain, keep in like service, and protect against damage during demolition operations. Do not interrupt existing utilities serving facilities, except when authorized in writing by authorities having jurisdiction. Provide temporary service during interruptions to existing utilities, as acceptable to governing authorities. Contractor shall disconnect and seal utilities serving structures to be demolished, prior to start of demolition work, upon written direction of Galveston County and utility owner.

PART 2 - PRODUCTS (Not used)

PART 3 - EXECUTION

3.01 DEMOLITION

A. General

Contractor shall comply with NFPA 241 and ANSI A 10.6 prior to and during commencement of demolition.

B. Pollution Control

Contractor shall comply with Section 01560 - Environmental Impact Controls of these Specifications. Use water sprinkling, temporary enclosures, and other suitable methods to limit dust and dirt rising and scattering in air to lowest practical level. Comply with governing EPA, OSHA, and local regulations pertaining to environmental protection. Do not create hazardous or objectionable conditions such as flooding and water pollution. Clean adjacent structures and improvements of dust, dirt, and debris caused by demolition operations, as directed by governing authorities. Return adjacent areas to condition existing prior to start of Work.

C. Building Demolition

Demolish building and structures completely and remove from Work Site. Use such methods as required to complete Work within limitations of governing regulations.

1. Proceed with demolition in systematic manner, from top of structure to ground.

2. Demolish concrete and masonry in small sections.

3. Break up and remove concrete and asphalt slabs-on-grade, unless otherwise shown to remain.

D. Below-Grade Construction

Demolish foundation walls to a depth of not less than 12 inches below subgrade or lowest foundation element. Demolish and remove below-grade wood, metal construction, floor construction, and concrete and asphalt slabs.

E. Filling Voids

1. Completely fill below-grade areas and voids resulting from demolition. Coordinate with work of Sections 02110 - Site Clearing, and 02200 - Earthwork of these Specifications.

2. Use satisfactory soil materials consisting of stone, gravel, and sand, free from debris, trash, frozen materials, roots and other organic matter.

3. Prior to placement of fill materials, ensure that areas to be filled are free of standing water, frost, frozen material, trash and debris.

4. Place fill materials in horizontal layers not exceeding 8 inches in loose depth. Compact each layer at optimum moisture content of fill material to a density as specified in Section 02200 - Earthwork of these Specifications.

5. After fill placement and compaction as specified, grade surface to meet adjacent contours and to provide flow to surface drainage structures.

3.02 DISPOSAL OF DEMOLISHED MATERIALS

A. General

Remove from Work Site debris, rubbish, and other materials resulting from demolition operations. Burning of removed materials from demolished structures will not be permitted on Site.

B. Removal

Safely transport demolished materials and dispose of legally off Site. Contractor shall comply with NFPA 241, ANSI A 10.6, and NFPA 30, as applicable to the Work of disposal and transport.

END OF SECTION 02 41 17

SECTION 033513 - CONCRETE FLOOR FINISHING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Surface treatment applied to cured concrete floors:

1. Concrete sealer.

B. Related Sections:

1. Section 033000 - Cast-in-Place Concrete: Prepared concrete floors ready to receive finish.
2. Section 079200 - Joint Sealants: Joint sealants applied to finished floors.

1.2 SUBMITTALS

A. Product Data: For each product indicated, including:

1. Manufacturer's specifications and test data.
2. Manufacturer's recommended installation procedures.

B. Test Reports: Provide certified test reports, prepared by an independent testing laboratory, confirming compliance with specified performance criteria.

C. Maintenance Data: Provide data on maintenance renewal of applied coatings.

1.3 QUALITY ASSURANCE

A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of products required for this Project.

1. Engage an installer who is certified in writing by manufacturer as qualified to apply products indicated.

B. Mockups: Apply mockups of each type finish, to demonstrate typical joints, surface finish, color variation, and quality standards for materials and workmanship.

1. Apply full-thickness mockups on 50 sf area selected by Architect.
2. Simulate finished lighting conditions for Architect's review of mockups.
3. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

C. Protection of Installed Slabs Receiving Floor Finishing: Protect concrete slabs against petroleum stains throughout construction, as stains cannot be removed satisfactorily.

1. Diaper all hydraulic-powered equipment.
2. Avoid parking vehicles on slab; If vehicles are necessary for the Work, place drop cloths under vehicles at all times.
3. Do not operate pipe cutting machines on slab.
4. Do not store steel on slab.
5. Do not allow acids and acidic detergents to come into contact with slab.

D. Preinstallation Conference: Conduct conference at Project site.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in original packages and containers, with seals unbroken, bearing manufacturer's labels indicating brand name and directions for storage and mixing with other components.

1.5 FIELD CONDITIONS

A. Coordinate the work with concrete floor placement and concrete floor curing.

B. Maintain light level equivalent to minimum 200 W light source, placed 8 feet above the floor surface, for each 425 sq ft of floor being finished.

C. Provide ventilation sufficient to prevent injurious gases from temporary heat or other sources affecting concrete.

D. Do not finish floors until interior heating system is operational.

E. Maintain ambient temperature of 50 degrees F minimum.

F. Close area to traffic after installation for time period recommended in writing by manufacturer.

PART 2 - PRODUCTS

2.1 PREPARATION

2.2 CONCRETE SEALERS

A. Products: Subject to compliance with requirements provide one of the following:

1. BASF Corporation, MasterKure CC 200 WB: www.basf.us.
2. Dayton Superior Corporation, Cure & Seal 1315 J22WB: www.daytonsuperior.com.
3. Euclid Chemical Co., Super Aqua-Cure VOX; www.euclidchemical.com.
4. Laticrete, L&M Dress & Seal WB 25: www.laticrete.com.
5. W.R. Meadows, Vocomp-20; www.wrmeadows.com.

B. Description: High-solids, waterbased, modified acrylic liquid polymer curing and sealing compound with the following characteristics:

1. ASTM C309, Type 1, Class A and Class B.
2. Solids Content: Minimum 20 percent by weight.
3. VOC Content: Complies with South Coast Air Quality Management District Rule No. 1168.

2.3 ACCESSORIES

A. Patching and Leveling Material: Moisture-, mildew-, and alkali-resistant product recommended in writing by sealer manufacturer and with minimum of 3000-psi compressive strength after 28 days when tested according to ASTM C109/C109M.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrate, with installer present, for conditions affecting performance of finish. Correct conditions detrimental to timely and proper work. Do not proceed until unsatisfactory conditions are corrected.

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

1. Installation of system indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Clean substrate of substances that might interfere with penetration or performance of sealer. Test for moisture content, according to manufacturer's written instructions, to ensure that surface is dry.

B. Repair damaged and deteriorated concrete according to manufacturer's written instructions.

1. Fill surface depressions and irregularities larger than the size of a dime with patching and leveling material.

C. Protect adjacent work, including sealant bond surfaces, from spillage or blow-over of sealer.

D. Coordination with Sealants: Do not apply sealer until adjacent joint sealants have been installed and cured.

1. Floor finishing may precede sealant application only if sealant adhesion and compatibility have been tested and verified using substrate, finish, and sealant materials identical to those used in the work.

E. Broom sweep and vacuum prepared concrete.

3.3 APPLICATION

A. Apply floor finishes in accordance with manufacturer's written instructions.

B. Sealer: Apply two coats to scheduled floors by power spray or roller.

1. Minimum Application Rate: Not less than manufacturer's recommended rate.

END OF SECTION

SECTION 042100 – ARCHITECTURAL UNIT MASONRY

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Architectural masonry veneer construction consisting of the following:

1. Face brick.
2. Limestone veneer.
3. Mortar for veneer.
4. Ties and anchors.
5. Embedded flashing.
6. Miscellaneous masonry accessories.

B. Products Installed but not Furnished under This Section:

1. Steel lintels in masonry veneer.

C. Related Sections:

1. Division 04 Section "Concrete Unit Masonry" for reinforced CMU construction.
2. Division 05 Section "Structural Steel Framing" for installing anchor sections of adjustable masonry anchors for connecting to structural steel frame.
3. Division 05 Section "Metal Fabrications" for furnishing steel lintels and shelf angles for unit masonry.
4. Division 07 Section “Thermal Insulation for cavity wall insulation.
5. Division 07 Section “Air Barriers” for air barrier membrane applied to backup walls.
6. Division 07 Section "Sheet Metal Flashing and Trim" for flashing and sheet metal related to masonry work.

1.2 PERFORMANCE REQUIREMENTS

A. Provide unit masonry that develops indicated net-area compressive strengths at 28 days.

1. Determine net-area compressive strength of masonry from average net-area compressive strengths of masonry units and mortar types (unit-strength method) according to Tables 1 and 2 in ACI 530.1/ASCE 6/TMS 602.
2. Determine net-area compressive strength of masonry by testing masonry prisms according to ASTM C 1314.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Indicate interface with adjacent materials.

B. Shop Drawings:

1. Detail interface of masonry with other adjacent and adjoining systems, including but not limited to, existing construction, air barriers, and flashings.

C. Samples for Verification: For each type and color of the following:

1. Face Brick, include at least 3 samples to indicate variations.
2. Limestone, include at least 3 samples to indicate variations.

3. Pigmented and colored-aggregate mortar. Make Samples using same sand and mortar ingredients to be used on Project.

D. Material Certificates: For each type of product indicated. Include statements of material properties indicating compliance with requirements including compliance with standards and type designations within standards.

1. For masonry units include material test reports substantiating compliance with requirements, produced within one year of submission.

E. Qualification Data: For testing agency.

F. Material Certificates: For each type and size of the following:

1. Masonry units.
   a. Include material test reports substantiating compliance with requirements.
   b. For brick, include size-variation data verifying that actual range of sizes falls within specified tolerances.
   c. For exposed brick, include test report for efflorescence according to ASTM C 67.
2. Cementitious materials. Include brand, type, and name of manufacturer.
3. Preblended, dry mortar mixes. Include description of type and proportions of ingredients.
4. Grout mixes. Include description of type and proportions of ingredients.
5. Reinforcing bars.
6. Joint reinforcement.
7. Anchors, ties, and metal accessories.

G. Mix Designs: For each type of mortar and grout. Include description of type and proportions of ingredients.

1. Include test reports for mortar mixes required to comply with property specification. Test according to ASTM C 109/C 109M for compressive strength, ASTM C 1506 for water retention, and ASTM C 91 for air content.
2. Include test reports, according to ASTM C 1019, for grout mixes required to comply with compressive strength requirement.

H. Statement of Compressive Strength of Masonry: For each combination of masonry unit type and mortar type, provide statement of average net-area compressive strength of masonry units, mortar type, and resulting net-area compressive strength of masonry determined according to Tables 1 and 2 in ACI 530.1/ASCE 6/TMS 602.

I. Cold-Weather and Hot-Weather Procedures: Detailed description of methods, materials, and equipment to be used to comply with requirements.

1.4 QUALITY ASSURANCE

A. Testing Agency Qualifications: Qualified according to ASTM C 1093 for testing indicated.

B. Source Limitations for Masonry Units: Obtain exposed masonry units of a uniform texture and color, or a uniform blend within the ranges accepted for these characteristics, from single source from single manufacturer for each product required.

C. Source Limitations for Mortar Materials: Obtain mortar ingredients of a uniform quality, including color for exposed masonry, from single manufacturer for each cementitious component and from single source or producer for each aggregate.

D. Masonry Standard: Comply with ACI 530.1/ASCE 6/TMS 602 unless modified by requirements in the Contract Documents.

E. 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 mockup of typical wall area as shown on Drawings in accordance with Section 014000 – Quality Control.
   a. Include a sealant-filled joint at least 16 inches long in mockup.
   b. Include lower corner of window opening at upper corner of exterior wall mockup. Make opening approximately 12 inches wide by 16 inches high. Include flashing end dam.
   c. Include through-wall flashing installed for a 24-inch length in corner of exterior wall mockup approximately 16 inches down from top of mockup, with a 12-inch length of flashing left exposed to view (omit masonry above half of flashing).
   d. Include metal studs, sheathing, sheathing joint-and-penetration treatment air barrier, veneer anchors, fabricated end dams, flashing, cavity drainage material, and weep holes in exterior masonry-veneer wall mockup.
2. Clean exposed faces of mockups with masonry cleaner as indicated.
3. Protect accepted mockups from the elements with weather-resistant membrane.
4. Approval of mockups is for color, texture, and blending of masonry units; relationship of mortar and sealant colors to masonry unit colors; tooling of joints; and aesthetic qualities of workmanship.
   a. Approval of mockups is also for other material and construction qualities specifically approved by Architect in writing.
   b. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless such deviations are specifically approved by Architect in writing.
5. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

F. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination."

1. Include the following attendees at a minimum:
   a. Owner
   b. Superintendent
   c. Subcontractor Foreman
   d. Architect,
   e. Waterproofing Consultant,
   f. Air barrier and flashing subcontractors for tie-in, as appropriate.
2. The following topics will need to be addressed along with normal pre-construction requirements:
   a. Delivery and storage requirements;
   b. Field mock-up requirements;
   c. Factory Quality Control testing;
   d. Field Quality Control testing;
   e. Tie-in to adjacent materials;
   f. Schedule.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store masonry units on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied. If units become wet, do not install until they are dry.

B. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.

C. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.

D. Deliver preblended, dry mortar mix in moisture-resistant containers designed for use with dispensing silos. Store preblended, dry mortar mix in delivery containers on elevated platforms, under cover, and in a dry location or in covered weatherproof dispensing silos.

E. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

1.6 PROJECT CONDITIONS

A. Protection of Masonry: During construction, cover tops of walls, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress.

1. Extend cover a minimum of 24 inches down both sides of walls and hold cover securely in place.
2. Where one wythe of multiwythe masonry walls is completed in advance of other wythes, secure cover a minimum of 24 inches down face next to unconstructed wythe and hold cover in place.

B. Do not apply uniform floor or roof loads for at least 12 hours and concentrated loads for at least three days after building masonry walls or columns.

C. Stain Prevention: Prevent grout, mortar, and soil from staining the face of masonry to be left exposed or painted. Immediately remove grout, mortar, and soil that come in contact with such masonry.

1. Protect base of walls from rain-splashed mud and from mortar splatter by spreading coverings on ground and over wall surface.
2. Protect sills, ledges, and projections from mortar droppings.
3. Protect surfaces of window and door frames, as well as similar products with painted and integral finishes, from mortar droppings.
4. Turn scaffold boards near the wall on edge at the end of each day to prevent rain from splashing mortar and dirt onto completed masonry.

D. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.

1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F and higher and will remain so until masonry has dried, but not less than seven days after completing cleaning.

E. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations for Masonry Units: Obtain exposed masonry units of a uniform texture and color, or a uniform blend within the ranges accepted for these characteristics, from single source from single manufacturer for each product required.

B. Source Limitations for Mortar Materials: Obtain mortar ingredients of a uniform quality, including color for exposed masonry, from single manufacturer for each cementitious component and from single source or producer for each aggregate.

2.2 MASONRY UNITS, GENERAL

A. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to contain chips, cracks, or other defects exceeding limits stated in the standard. Do not use units where such defects will be exposed in the completed Work.

B. Fire-Resistance Ratings: Where indicated, provide units that comply with requirements for fire-resistance ratings indicated as determined by testing according to ASTM E 119, by equivalent masonry thickness, or by other means, as acceptable to authorities having jurisdiction.

2.3 BRICK

A. General: Provide shapes indicated and as follows, with exposed surfaces matching finish and color of exposed faces of adjacent units:

1. For ends of sills and caps and for similar applications that would otherwise expose unfinished brick surfaces, provide units without cores or frogs and with exposed surfaces finished.
2. Provide special shapes for applications where stretcher units cannot accommodate special conditions, including those at corners, movement joints, bond beams, sashes, and lintels.
3. Provide special shapes for applications requiring brick of size, form, color, and texture on exposed surfaces that cannot be produced by sawing.
4. Provide special shapes for applications where shapes produced by sawing would result in sawed surfaces being exposed to view.

B. Face Brick: ASTM C 216 or C652, Grade SW, Type FBS.

1. Size (Actual Dimensions): Modular; 3-5/8 inches wide by 2-1/4 inches high by 7-5/8 inches long.
2. Bond: Half running bond.
3. Initial Rate of Absorption: Less than 30 g/30 sq. in. per minute when tested per ASTM C 67, and measured in the field and documented prior to installation.
4. Efflorescence: Provide brick that has been tested according to ASTM C 67 and is rated "not effloresced."

2.4 LIMESTONE VENEER

2.5 MORTAR MATERIALS

A. Portland Cement: ASTM C 150, Type I or II, except Type III may be used for cold-weather construction. Provide natural color or white cement as required to produce mortar color indicated.

B. Hydrated Lime: ASTM C 207, Type S.

C. Portland Cement-Lime Mix: Packaged blend of portland cement and hydrated lime containing no other ingredients.

D. Masonry Cement: ASTM C 91.

1. Products: Subject to compliance with requirements, provide one of the following:
   a. Holcim (US) Inc.; White Mortamix Masonry Cement.
   b. Lafarge North America Inc.; Trinity White Masonry Cement.
   c. Lehigh Cement Company; Lehigh White Masonry Cement.

E. Colored Cement Product: Packaged blend made from portland cement and hydrated lime or masonry cement and mortar pigments, all complying with specified requirements, and containing no other ingredients.

1. Colored Portland Cement-Lime Mix:
   a. Products: Subject to compliance with requirements, provide one of the following:
      1) Holcim (US) Inc.; Rainbow Mortamix Custom Color Cement/Lime.
      2) Lafarge North America Inc.; Eaglebond Portland & Lime.
      3) Lehigh Cement Company; Lehigh Custom Color Portland/Lime Cement.
2. Colored Masonry Cement:
   a. Products: Subject to compliance with requirements, provide one of the following:
      1) Holcim (US) Inc.; Rainbow Mortamix Custom Color Masonry Cement.
      2) Lafarge North America Inc.; U.S. Cement Custom Color Masonry Cement.
      3) Lehigh Cement Company; Lehigh Custom Color Masonry Cement.
3. Formulate blend as required to produce color indicated or, if not indicated, as selected from manufacturer's standard colors.
4. Pigments shall not exceed 10 percent of portland cement by weight.
5. Pigments shall not exceed 5 percent of masonry cement by weight.

F. Aggregate for Mortar: ASTM C 144.

1. For mortar that is exposed to view, use washed aggregate consisting of natural sand or crushed stone.
2. For joints less than 1/4 inch thick, use aggregate graded with 100 percent passing the No. 16 sieve.
3. White-Mortar Aggregates: Natural white sand or crushed white stone.
4. Colored-Mortar Aggregates: Natural sand or crushed stone of color necessary to produce required mortar color.

G. Cold-Weather Admixture: Nonchloride, noncorrosive, accelerating admixture complying with ASTM C 494/C 494M, Type C, and recommended by manufacturer for use in masonry mortar of composition indicated.

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. Euclid Chemical Company (The); Accelguard 80.
   b. Grace Construction Products, W. R. Grace & Co. - Conn.; Morset.
   c. Sonneborn Products, BASF Aktiengesellschaft; Trimix-NCA.

H. Water: Potable.

2.6 TIES AND ANCHORS

A. Materials: Provide ties and anchors specified in this article that are made from materials that comply with the following unless otherwise indicated.

1. Hot-Dip Galvanized, Carbon-Steel Wire: ASTM A 82/A 82M; with ASTM A 153/A 153M, Class B-2 coating.
2. Stainless Steel Wire: ASTM A580/A580M, Type 304.
3. Steel Sheet, Galvanized after Fabrication: ASTM A 1008/A 1008M, Commercial Steel, with ASTM A 153/A 153M, Class B coating.
4. Stainless Steel Sheet: ASTM A240/A240M or ASTM A666, Type 304.

B. Wire Ties, General: Unless otherwise indicated, size wire ties to extend at least halfway through veneer but with at least 5/8-inch cover on outside face.

C. Adjustable Anchors for Connecting to Structural Steel Framing: Provide anchors that allow vertical or horizontal adjustment but resist tension and compression forces perpendicular to plane of wall.

1. Anchor Section for Welding to Steel Frame: Crimped 1/4-inch- diameter, hot-dip galvanized steel wire. Mill-galvanized wire may be used at interior walls unless otherwise indicated.
2. Tie Section: Triangular-shaped wire tie, sized to extend within 1 inch of masonry face, made from 0.25-inch- diameter, hot-dip galvanized steel wire. Mill-galvanized wire may be used at interior walls unless otherwise indicated.

D. Adjustable Masonry-Veneer Anchors:

1. General: Provide anchors that allow vertical adjustment but resist tension and compression forces perpendicular to plane of wall, for attachment over sheathing to wood or metal studs, and as follows:
   a. Structural Performance Characteristics: Capable of withstanding a 100-lbf load in both tension and compression without deforming or developing play in excess of 0.05 inch.

2. Products: Subject to compliance with requirements, provide the following:
   a. Studs: Hohmann & Barnard, Inc.; HB-213-2X
   b. Masonry and Concrete: Hohmann & Barnard, Inc.; HB-5213

3. Anchor Materials - Brick Walls:
   a. Fabricate sheet metal anchor sections and other sheet metal parts from 0.10-inch-thick (12 gage) steel sheet, galvanized after fabrication.
   b. Wire Ties: Triangular-, rectangular-, or T-shaped wire ties fabricated from 0.25-inch- diameter, hot-dip galvanized-steel wire unless otherwise indicated.

4. Anchor Materials - Limestone Walls:
   a. Fabricate sheet metal anchor sections and other sheet metal parts from 0.10-inch-thick (12 gage) stainless steel sheet.

b. Wire Ties: Triangular-, rectangular-, or T-shaped wire ties fabricated from 0.25-inch- diameter stainless steel wire.

2.7 EMBEDDED FLASHING MATERIALS

A. Metal Flashing: Provide metal flashing complying with SMACNA's "Architectural Sheet Metal Manual" and Division 07 Section "Sheet Metal Flashing and Trim".

1. Stainless Steel: ASTM A 240/A 240M, Type 304, 0.025 inch (24 gage) thick.
2. Fabricate continuous flashings in sections 96 inches long minimum, but not exceeding 12 feet. Provide splice plates and sealant at joints of formed, smooth metal flashing.
3. Fabricate through-wall metal flashing embedded in masonry from stainless steel.
4. Fabricate through-wall flashing with drip edge unless otherwise indicated. Fabricate by extending flashing 1/2 inch out from wall, with outer edge bent down 30 degrees and hemmed.
5. Metal Drip Edge: Fabricate from stainless steel. Extend at least 3 inches into wall and 1/2 inch out from wall, with outer edge bent down 30 degrees and hemmed.

B. Flexible Flashing: Provide self-adhering rubberized asphalt flashings complying with Section 072726 “Air Barriers" and the following:

1. Accessories: Provide preformed corners, end dams, other special shapes, and seaming materials produced by flashing manufacturer.
2. Provide complete single source warranty with the air barrier system.

C. Application: Unless otherwise indicated, use the following:

1. Where flashing is indicated to receive counterflashing, use metal flashing.
2. Where flashing is indicated to be turned down at or beyond the wall face, use metal flashing.
3. Where flashing is partly exposed and is indicated to terminate at the wall face, use metal flashing.
4. Where flashing is fully concealed, use flexible flashing, except use metal flashing at foundation sill and above openings.

D. Solder and Sealants for Sheet Metal Flashings:

1. Solder: As specified in Section 076200 "Sheet Metal Flashing and Trim."
2. Sealant: Silicone type at exposed conditions and butyl type at concealed conditions, as specified in Section 079200 “Joint Sealants.”

2.8 MISCELLANEOUS MASONRY ACCESSORIES

A. Compressible Filler: Premolded filler strips complying with ASTM D 1056, Grade 2A1; compressible up to 35 percent; of width and thickness indicated; formulated from neoprene, urethane or PVC.

B. Cavity Drainage Material: Dovetail shaped, free-draining mesh, made from polymer strands that will not degrade within the wall cavity. Flat top material not acceptable.

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. Mason; ProNet Green-2.
   b. Mortar Net USA, Ltd.; Mortar Net.

2. Provide the following configuration:

a. Strips, 2-inch deep by 10 inches high, with dovetail shaped notches 7 inches deep that prevent clogging with mortar droppings.

C. Weep/Vent Products: Use the following unless otherwise indicated:

1. Mesh Weep/Vent: Free-draining mesh; made from polyethylene strands, full height and width of head joint and depth 1/8 inch less than depth of outer wythe; in color selected from manufacturer's standard.
   a. Products: Subject to compliance with requirements, provide the following for locations other than at foundation sills:
      1) Mortar Net USA, Ltd.; Mortar Net Weep Vents.

2.9 MASONRY CLEANERS

A. Proprietary Cleaner: Manufacturer's standard-strength non-acidic cleaner designed for removing mortar/grout stains, efflorescence, and other new construction stains from new masonry without discoloring or damaging masonry surfaces. Use product expressly approved for intended use by cleaner manufacturer and manufacturer of masonry units being cleaned. Use product line which is formulated for color of brick specified.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Diedrich Technologies, Inc.
   b. EaCo Chem, Inc.
   c. ProSoCo, Inc.

2.10 MORTAR MIXES

A. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures, unless otherwise indicated.

1. Do not use calcium chloride in mortar.
2. Use portland cement-lime or masonry cement mortar unless otherwise indicated.
3. Add cold-weather admixture (if used) at same rate for all mortar that will be exposed to view, regardless of weather conditions, to ensure that mortar color is consistent.

B. Preblended, Dry Mortar Mix: Furnish dry mortar ingredients in form of a preblended mix. Measure quantities by weight to ensure accurate proportions, and thoroughly blend ingredients before delivering to Project site.

C. Mortar for Unit Masonry: Comply with ASTM C 270, Proportion Specification. Provide Type N mortar for masonry veneer unless otherwise indicated.

D. Pigmented Mortar: Use colored cement product or select and proportion pigments with other ingredients to produce color required. Do not add pigments to colored cement products.

1. Pigments shall not exceed 10 percent of portland cement by weight.
2. Pigments shall not exceed 5 percent of masonry cement by weight.
3. Mix to match Architect's sample.
4. Application: Unless otherwise instructed, use pigmented mortar for exposed mortar joints with the following units:
   a. Face brick.
   b. Limestone veneer.

PART 3 - EXECUTION

3.1 PREPARATION AND COORDINATION – AIR BARRIER

A. Coordinate work of this Section with installation of air barrier specified in Section 072726 “Air Barriers.”

1. Before beginning work, inspect air barrier system to verity that air barrier installation is complete, sealed to embedded and penetrating items, and ready to receive work of this Section. Do not begin work prior to inspection of air barrier installation.
2. As work progresses, tie-in and seal embedded and thru-wall flashings to air barrier system to create an air- and water-tight envelope.

3.2 EXAMINATION

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

1. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of work.
2. Verify that foundations and brick ledges are within tolerances specified.
3. Verify that curtain walls, storefronts, and other items built into the work of this Section are in place and sealed air- and water-tight.

B. Before installation, measure the Initial Rate of Absorption and document. Keep documentation for review during construction and at Project Closeout.

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

3.3 INSTALLATION, GENERAL

A. Thickness: Build cavity walls to thickness shown.

B. Leave openings for equipment to be installed before completing masonry. After installing equipment, complete masonry to match the construction immediately adjacent to opening.

C. Use full-size units without cutting if possible. If cutting is required to provide a continuous pattern or to fit adjoining construction, cut units with motor-driven saws; provide clean, sharp, unchipped edges. Allow units to dry before laying unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.

D. Select and arrange units for exposed unit masonry to produce a uniform blend of colors and textures.

1. Mix units from several pallets or cubes as they are placed.

E. Wetting of Brick: Wet brick before laying if initial rate of absorption exceeds 30 g/30 sq. in. per minute when tested per ASTM C 67. Allow units to absorb water so they are damp but not wet at time of laying.

3.4 CAVITY WALL INSULATION

A. Installing Cavity-Wall Insulation: Place small dabs of adhesive, spaced approximately 12 inches o.c. both ways, on inside face of insulation boards, or attach with plastic fasteners designed for this purpose. Fit courses of insulation between wall ties and other confining obstructions in cavity, with edges butted tightly both ways. Press units firmly against inside wythe of masonry or other construction as shown.

1. Fill cracks and open gaps in insulation with crack sealer compatible with insulation and masonry.

3.5 LAYING MASONRY VENEER

A. Lay out veneer in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets. Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.

B. Bond Pattern for Exposed Masonry: Unless otherwise indicated, lay exposed masonry in bond pattern indicated on Drawings; do not use units with less than nominal 4-inch horizontal face dimensions at corners or jambs.

C. Keep cavities clean of mortar droppings and other materials during construction. Bevel beds away from cavity, to minimize mortar protrusions into cavity. Do not attempt to trowel or remove mortar fins protruding into cavity.

D. Stopping and Resuming Work: Stop work by racking back units in each course from those in course below; do not tooth. When resuming work, clean masonry surfaces that are to receive mortar, remove loose masonry units and mortar, and wet brick if required before laying fresh masonry.

E. Built-in Work: As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry around built-in items.

F. Fill space between steel frames and masonry solidly with mortar unless otherwise indicated.

3.6 MORTAR BEDDING AND JOINTING

A. Lay solid masonry units with completely filled bed and head joints; butter ends with sufficient mortar to fill head joints and shove into place. Do not deeply furrow bed joints or slush head joints.

B. Lay hollow brick with face shells fully bedded in mortar and with head joints of depth equal to bed joints. At starting course, fully bed entire units, including area under cells.

1. At anchors and ties, fully bed units and fill cells with mortar as needed to fully embed anchors and ties in mortar.

C. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness unless otherwise indicated.

3.7 ANCHORING MASONRY VENEERS

A. Anchor masonry veneers to wall framing and concrete and masonry backup with masonry-veneer anchors to comply with the following requirements:

1. Fasten screw-attached anchors through sheathing to wall framing and to concrete and masonry backup with metal fasteners of type indicated. Use two fasteners unless anchor design only uses one fastener.
2. Embed wire ties in masonry joints. Provide not less than 2 inches of air space between back of masonry veneer and face of sheathing.
3. Locate anchor sections to allow maximum vertical differential movement of ties up and down.
4. Space anchors not more than 16 inches o.c. vertically and 16 inches o.c. horizontally. Install additional anchors within 12 inches of openings and at intervals, not exceeding 8 inches, around perimeter.
5. Where fasteners penetrate air barrier, provide gasketed fasteners or take steps to maintain membrane continuity as instructed by air barrier manufacturer.

3.8 CONTROL AND EXPANSION JOINTS

A. General: Install control and expansion joint materials in unit masonry as masonry progresses. Do not allow materials to span control and expansion joints without provision to allow for in-plane wall or partition movement.

B. Form expansion joints in unit masonry as follows:

1. Form open joint full depth of brick or limestone wythe and of width indicated, but not less than 3/8 inch width for installation of sealant and backer rod specified in Division 07 Section "Joint Sealants."

C. Provide horizontal, pressure-relieving joints by either leaving an air space or inserting a compressible filler of width required for installing sealant and backer rod specified in Division 07 Section "Joint Sealants," but not less than 3/8 inch.

1. Locate horizontal, pressure-relieving joints beneath shelf angles supporting masonry.

3.9 FLASHING, WEEP HOLES, CAVITY DRAINAGE, AND VENTS

A. General: Install weep holes and continuous embedded flashing in masonry at foundation sill, shelf angles, lintels, ledges, other obstructions to downward flow of water in wall, and where indicated. Install vents at shelf angles, ledges, and other obstructions to upward flow of air in cavities, and where indicated.

1. Coordinate flashings with installation of air barrier membrane under Section 072726. Utilize air barrier materials or materials compatible with air barrier.

B. Install flashing as follows unless otherwise indicated:

1. Prepare masonry surfaces so they are smooth and free from projections that could puncture flashing. Where flashing is within mortar joint, place through-wall flashing on sloping bed of mortar and cover with mortar. Before covering with mortar, seal penetrations in flashing with adhesive, sealant, or tape as recommended by flashing manufacturer.
2. Set flashing in bed of sealant or mastic in accordance with Division 07 for flashing at and below grade.

3. At masonry-veneer walls, extend flashing through veneer, across air space behind veneer, and up face of sheathing at least 8 inches; with upper edge tucked under mastic tape and air barrier membrane, lapping at least 4 inches and secured by termination bar.
4. At lintels and shelf angles, extend flashing a minimum of 6 inches into masonry at each end. At heads and sills, extend flashing 6 inches at ends and turn up not less than 2 inches to form end dams.
5. Interlock end joints of sheet metal flashing by overlapping not less than 1-1/2 inches or as recommended by flashing manufacturer, and seal lap with elastomeric sealant complying with requirements in Division 07 Section "Joint Sealants" for application indicated.
6. Install metal drip edges beneath flexible flashing at exterior face of wall. Stop flexible flashing 1/2 inch back from outside face of wall and adhere flexible flashing to top of metal drip edge.

C. Install receivers and nailers for flashing and other related construction where they are shown to be built into masonry.

D. Install weep holes in head joints of first course of veneer masonry immediately above embedded flashing and as follows:

1. Use specified weep/vent products to form weep holes.
2. Space weep holes 24 inches o.c. unless otherwise indicated.

E. Place cavity drainage material in cavities to comply with configuration requirements for cavity drainage material in "Miscellaneous Masonry Accessories" Article.

3.10 LOOSE LINTELS

A. Install galvanized steel lintels as indicated.

B. Provide lintels where shown and where openings of more than 12 inches for brick-size units are shown without structural steel or other supporting lintels.

C. Provide minimum bearing of 8 inches at each jamb unless otherwise indicated. Field cutting of lintels is allowed. Coat cut edges with galvanizing repair paint prior to installation.

3.11 FIELD QUALITY CONTROL

A. Testing and Inspecting: Owner will engage special inspectors to perform tests and inspections and prepare reports. Allow inspectors access to scaffolding and work areas, as needed to perform tests and inspections. Retesting of materials that fail to comply with specified requirements shall be done at Contractor's expense.

B. Inspections: Provide the following special inspections according to the "International Building Code."

1. Begin masonry construction only after inspectors have verified proportions of site-prepared mortar.

C. Testing Prior to Construction: One set of tests.

D. Testing Frequency: One set of tests for each 5000 sq. ft. of wall area or portion thereof.

E. Mortar Aggregate Ratio Test (Proportion Specification): For each mix provided, according to ASTM C 780.

F. Mortar Test (Property Specification): For each mix provided, according to ASTM C 780. Test mortar for mortar air content and compressive strength.

G. Prism Test: For each type of construction provided, according to ASTM C 1314 at 7 days and at 28 days.

3.12 REPAIRING AND POINTING

A. Remove and replace masonry units that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Install new units to match adjoining units; install in fresh mortar, pointed to eliminate evidence of replacement.

B. Pointing: During the tooling of joints, enlarge voids and holes, except weep holes, and completely fill with mortar. Point up joints, including corners, openings, and adjacent construction, to provide a neat, uniform appearance. Prepare joints for sealant application, where indicated.

3.13 TOLERANCES

A. Dimensions and Locations of Elements:

1. For dimensions in cross section or elevation do not vary by more than plus 1/2 inch or minus 1/4 inch.
2. For location of elements in plan do not vary from that indicated by more than plus or minus 1/2 inch.
3. For location of elements in elevation do not vary from that indicated by more than plus or minus 1/4 inch in a story height or 1/2 inch total.

B. Lines and Levels:

1. For bed joints and top surfaces of bearing walls do not vary from level by more than 1/4 inch in 10 feet, or 1/2 inch maximum.
2. For conspicuous horizontal lines, such as lintels, sills, parapets, and reveals, do not vary from level by more than 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2 inch maximum.
3. For vertical lines and surfaces do not vary from plumb by more than 1/4 inch in 10 feet, 3/8 inch in 20 feet, or 1/2 inch maximum.
4. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2 inch maximum.
5. For lines and surfaces do not vary from straight by more than 1/4 inch in 10 feet, 3/8 inch in 20 feet, or 1/2 inch maximum.
6. For vertical alignment of exposed head joints, do not vary from plumb by more than 1/4 inch in 10 feet, or 1/2 inch maximum.
7. For faces of adjacent exposed masonry units, do not vary from flush alignment by more than 1/16 inch except due to warpage of masonry units within tolerances specified for warpage of units.

C. Joints:

1. For bed joints, do not vary from thickness indicated by more than plus or minus 1/8 inch, with a maximum thickness limited to 1/2 inch.
2. For exposed bed joints, do not vary from bed-joint thickness of adjacent courses by more than 1/8 inch.
3. For head and collar joints, do not vary from thickness indicated by more than plus 3/8 inch or minus 1/4 inch.

4. For exposed head joints, do not vary from thickness indicated by more than plus or minus 1/8 inch. Do not vary from adjacent bed-joint and head-joint thicknesses by more than 1/8 inch.
5. For exposed bed joints and head joints of stacked bond, do not vary from a straight line by more than 1/16 inch from one masonry unit to the next.

3.14 CLEANING

A. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.

B. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:

1. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes.
2. Protect adjacent surfaces from contact with cleaner.
3. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing surfaces thoroughly with clear water.
4. Clean brick by bucket-and-brush hand-cleaning method described in BIA Technical Notes 20.
5. Clean masonry with a proprietary acidic cleaner applied according to manufacturer's written instructions.
6. Clean concrete masonry by cleaning method indicated in NCMA TEK 8-2A applicable to type of stain on exposed surfaces.
7. Application:
   a. Clean from bottom up; prevent cleaning materials and rinse water from contacting non-cementitious materials.
   b. Clean in accordance with manufacturer's instructions and recommendations, product data, and container label instructions.
   c. Mix materials in strict accordance with manufacturer’s instructions; do not dilute unless permitted by manufacturer.
   d. Prevent overspray, wind drift, and splash onto surfaces not to be treated.
   e. No high pressure washers are permitted.
   f. Low pressure spray for wetting and rinsing is permitted. Pressure should be in the range of 400-1000 psi. Equipment should produce 6-8 gallons of water per minute using a 15-40 degree fan tip (no fan tip less than a 15 degree is allowed).
   g. No metal tools or wire brushes are allowed for cleaning of masonry. Use a waste piece of same masonry material for scraping of installed material.

END OF SECTION

SECTION 042200 - CONCRETE UNIT MASONRY

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Concrete masonry units.
2. Decorative concrete masonry units.
3. Mortar and grout.
4. Masonry-joint reinforcement.
5. Miscellaneous masonry accessories.

B. Related Requirements:

1. Section 042100 "Architectural Unit Masonry" for face brick.

1.2 DEFINITIONS

A. CMU(s): Concrete masonry unit(s).

B. Reinforced Masonry: Masonry containing reinforcing steel in grouted cells.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For testing agency.

B. Material Certificates: For each type and size of the following:

1. Masonry units.
   a. Include data on material properties.
   b. For masonry units used in structural masonry, include data and calculations establishing average net-area compressive strength of units.
2. Cementitious materials. Include name of manufacturer, brand name, and type.
3. Mortar admixtures.
4. Joint reinforcement.
5. Anchors, ties, and metal accessories.

C. Mix Designs: For each type of mortar and grout. Include description of type and proportions of ingredients.

1. Include test reports for mortar mixes required to comply with property specification. Test according to ASTM C 109/C 109M for compressive strength, ASTM C 1506 for water retention, and ASTM C 91/C 91M for air content.
2. Include test reports, according to ASTM C 1019, for grout mixes required to comply with compressive strength requirement.

D. Statement of Compressive Strength of Masonry: For each combination of masonry unit type and mortar type, provide statement of average net-area compressive strength of masonry units, mortar type, and resulting net-area compressive strength of masonry determined according to TMS 602/ACI 530.1/ASCE 6.

E. Cold-Weather and Hot-Weather Procedures: Detailed description of methods, materials, and equipment to be used to comply with requirements.

1.6 QUALITY ASSURANCE

A. Testing Agency Qualifications: Qualified according to ASTM C 1093 for testing indicated.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Store masonry units on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied. If units become wet, do not install until they are dry.

B. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.

C. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.

D. Deliver preblended, dry mortar mix in moisture-resistant containers. Store preblended, dry mortar mix in delivery containers on elevated platforms in a dry location or in covered weatherproof dispensing silos.

E. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

1.8 FIELD CONDITIONS

A. Protection of Masonry: During construction, cover tops of walls, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress.

1. Extend cover a minimum of 24 inches down both sides of walls, and hold cover securely in place.

B. Do not apply uniform floor or roof loads for at least 12 hours and concentrated loads for at least three days after building masonry walls or columns.

C. Stain Prevention: Prevent grout, mortar, and soil from staining the face of masonry to be left exposed or painted. Immediately remove grout, mortar, and soil that come in contact with such masonry.

1. Protect base of walls from rain-splashed mud and from mortar splatter by spreading coverings on ground and over wall surface.
2. Protect sills, ledges, and projections from mortar droppings.
3. Protect surfaces of window and door frames, as well as similar products with painted and integral finishes, from mortar droppings.
4. Turn scaffold boards near the wall on edge at the end of each day to prevent rain from splashing mortar and dirt onto completed masonry.

D. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in TMS 602/ACI 530.1/ASCE 6.

1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg and higher and will remain so until masonry has dried, but not less than seven days after completing cleaning.

E. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in TMS 602/ACI 530.1/ASCE 6.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations for Mortar Materials: Obtain mortar ingredients of a uniform quality, from single manufacturer for each cementitious component and from single source or producer for each aggregate.

2.2 PERFORMANCE REQUIREMENTS

A. Provide structural unit masonry that develops indicated net-area compressive strengths at 28 days.

1. Determine net-area compressive strength of masonry from average net-area compressive strengths of masonry units and mortar types (unit-strength method) according to TMS 602/ACI 530.1/ASCE 6.

2.3 UNIT MASONRY, GENERAL

A. Masonry Standard: Comply with TMS 602/ACI 530.1/ASCE 6 except as modified by requirements in the Contract Documents.

B. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to contain chips, cracks, or other defects exceeding limits stated. Do not use units where such defects are exposed in the completed Work.

C. Fire-Resistance Ratings: Comply with requirements for fire-resistance-rated assembly designs indicated.

1. Fire-resistance-rated assembly designs are based on standard concrete masonry units; special fire-rated units are not required.

2.4 CONCRETE MASONRY UNITS

A. Shapes: Provide shapes indicated and as follows, with exposed surfaces matching exposed faces of adjacent units unless otherwise indicated.

1. Provide special shapes for lintels, corners, bonding, and other special conditions.
2. Provide square-edged units for outside corners unless otherwise indicated.

B. Integral Water Repellent: Provide units made with integral water repellent for exposed units.

1. Integral Water Repellent: Liquid polymeric, integral water-repellent admixture that does not reduce flexural bond strength. Units made with integral water repellent, when tested according to ASTM E514/E514M as a wall assembly made with mortar containing integral water-repellent manufacturer's mortar additive, with test period extended to 24 hours, shall show no visible water or leaks on the back of test specimen.

C. CMUs: ASTM C 90.

1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 2,150 psi.
2. Density Classification: Lightweight.
3. Size (Width): Manufactured to dimensions 3/8 inch less-than-nominal dimensions.

D. Decorative CMUs: ASTM C90.

1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 2150 psi.
2. Density Classification: Lightweight.
3. Size (Width): Manufactured to dimensions specified in "CMUs" Paragraph.
4. Pattern and Texture:
   a. Standard pattern, ground-face finish.
   b. Standard pattern, split-face finish.
5. Colors: As selected by Architect from manufacturer's full range.
6. Special Aggregate: Provide units made with aggregate matching aggregate in Architect's sample.

E. Masonry Lintels: Prefabricated or built-in-place masonry lintels made from bond beam CMUs matching adjacent CMUs in color, texture, and density classification, with reinforcing bars placed as indicated and filled with coarse grout. Cure precast lintels before handling and installing. Temporarily support built-in-place lintels until cured.

2.5 MORTAR AND GROUT MATERIALS

A. Portland Cement: ASTM C 150/C 150M, Type I or II, except Type III may be used for cold-weather construction.

B. Hydrated Lime: ASTM C 207, Type S.

C. Portland Cement-Lime Mix: Packaged blend of portland cement and hydrated lime containing no other ingredients.

D. Masonry Cement: ASTM C 91/C 91M.

E. Mortar Cement: ASTM C 1329/C 1329M.

F. Colored Cement Product: Packaged blend made from portland cement and hydrated lime or masonry cement and mortar pigments, all complying with specified requirements, and containing no other ingredients.

1. Colored Portland Cement-Lime Mix:
   a. Products: Subject to compliance with requirements, provide one of the following:
      1) Holcim (US) Inc.; Rainbow Mortamix Custom Color Cement/Lime.
      2) Lafarge North America Inc.; Eaglebond Portland & Lime.
      3) Lehigh Cement Company; Lehigh Custom Color Portland/Lime Cement.

2. Colored Masonry Cement:
   a. Products: Subject to compliance with requirements, provide one of the following:
      1) Holcim (US) Inc.; Rainbow Mortamix Custom Color Masonry Cement.
      2) Lafarge North America Inc.; U.S. Cement Custom Color Masonry Cement.
      3) Lehigh Cement Company; Lehigh Custom Color Masonry Cement.

3. Formulate blend as required to produce color indicated or, if not indicated, as selected from manufacturer's standard colors.
4. Pigments shall not exceed 10 percent of portland cement by weight.
5. Pigments shall not exceed 5 percent of masonry cement by weight.

G. Aggregate for Mortar: ASTM C 144.

1. For mortar that is exposed to view, use washed aggregate consisting of natural sand or crushed stone.
2. For joints less than 1/4 inch thick, use aggregate graded with 100 percent passing the No. 16 sieve.
3. White-Mortar Aggregates: Natural white sand or crushed white stone.
4. Colored-Mortar Aggregates: Natural sand or crushed stone of color necessary to produce required mortar color.

H. Aggregate for Grout: ASTM C 404.

I. Cold-Weather Admixture: Nonchloride, noncorrosive, accelerating admixture complying with ASTM C 494/C 494M, Type C, and recommended by manufacturer for use in masonry mortar of composition indicated.

J. Water: Potable.

2.6 REINFORCEMENT

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

B. Masonry-Joint Reinforcement, General: Ladder type complying with ASTM A 951/A 951M; mill galvanized for interior walls and hot-dip galvanized for exterior walls.

1. Provide in lengths of not less than 10 feet, with prefabricated corner and tee units.

2.7 TIES AND ANCHORS

A. General: Ties and anchors shall extend at least 1-1/2 inches into masonry but with at least a 5/8-inch cover on outside face.

B. Materials: Provide ties and anchors specified in this article that are made from materials that comply with the following unless otherwise indicated:

1. Hot-Dip Galvanized, Carbon-Steel Wire: ASTM A 82/A 82M, with ASTM A 153/A 153M, Class B-2 coating.
2. Steel Sheet, Galvanized after Fabrication: ASTM A 1008/A 1008M, Commercial Steel, with ASTM A 153/A 153M, Class B coating.
3. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.

C. Adjustable Anchors for Connecting to Structural Steel Framing: Provide anchors that allow vertical or horizontal adjustment but resist tension and compression forces perpendicular to plane of wall.

1. Anchor Section for Welding to Steel Frame: Crimped 1/4-inch- diameter, hot-dip galvanized steel wire.
2. Tie Section: Triangular-shaped wire tie made from 1/4-inch- diameter, hot-dip galvanized steel wire.

D. Adjustable Anchors for Connecting to Concrete: Provide anchors that allow vertical or horizontal adjustment but resist tension and compression forces perpendicular to plane of wall.

1. Connector Section: Dovetail tabs for inserting into dovetail slots in concrete and attached to tie section; formed from 0.105-inch- thick steel sheet, galvanized after fabrication.
2. Tie Section: Triangular-shaped wire tie made from 1/4-inch- diameter, hot-dip galvanized steel wire. Mill-galvanized wire may be used at interior walls unless otherwise indicated.

E. Rigid Anchors: Fabricate from steel bars 1-1/2 inches wide by 1/4 inch thick by 24 inches long, with ends turned up 2 inches or with cross pins unless otherwise indicated.

1. Corrosion Protection: Hot-dip galvanized to comply with ASTM A 153/A 153M.

2.8 MISCELLANEOUS MASONRY ACCESSORIES

A. Compressible Filler: Premolded filler strips complying with ASTM D 1056, Grade 2A1; compressible up to 35 percent; of width and thickness indicated; formulated from neoprene urethane or PVC.

B. Bond-Breaker Strips: Asphalt-saturated felt complying with ASTM D 226/D 226M, Type I (No. 15 asphalt felt).

2.9 MORTAR AND GROUT MIXES

A. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures unless otherwise indicated.

1. Do not use calcium chloride in mortar or grout.
2. Limit cementitious materials in mortar for exterior and reinforced masonry to portland cement and lime.
3. Add cold-weather admixture (if used) at same rate for all mortar that will be exposed to view, regardless of weather conditions, to ensure that mortar color is consistent.

B. Mortar for Unit Masonry: Comply with ASTM C 270, Proportion Specification. Provide the following types of mortar for applications stated unless another type is indicated.

1. For masonry below grade or in contact with earth, use Type M or S.
2. For reinforced masonry, use Type S.

3. For exterior, above-grade, load-bearing and nonload-bearing walls and parapet walls; for interior load-bearing walls; for interior nonload-bearing partitions; and for other applications where another type is not indicated, use Type N.

C. Pigmented Mortar: Use colored cement product or select and proportion pigments with other ingredients to produce color required. Do not add pigments to colored cement products.

1. Pigments shall not exceed 10 percent of portland cement by weight.
2. Pigments shall not exceed 5 percent of masonry cement by weight.
3. Mix to match Architect's sample.
4. Application: Unless otherwise instructed, use pigmented mortar for exposed mortar joints with the following units:
   a. Decorative CMUs.

D. Grout for Unit Masonry: Comply with ASTM C 476.

1. Use grout of type indicated or, if not otherwise indicated, of type (fine or coarse) that will comply with TMS 602/ACI 530.1/ASCE 6 for dimensions of grout spaces and pour height.
2. Proportion grout in accordance with ASTM C 476, for a 28-day compressive strength of not less than 2,000 psi.
3. Provide grout with a slump of 8 to 11 inches as measured according to ASTM C 143/C 143M.

PART 3 - EXECUTION

3.1 EXAMINATION

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

1. Verify that slabs and foundations are within tolerances specified.
2. Verify that reinforcing dowels are properly placed.
3. Verify that substrates are free of substances that would impair mortar bond.

B. Before installation, examine rough-in and built-in construction for piping systems to verify actual locations of piping.

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

3.2 INSTALLATION, GENERAL

A. Build chases and recesses to accommodate items specified in this and other Sections.

B. Leave openings for equipment to be installed before completing masonry. After installing equipment, complete masonry to match construction immediately adjacent to opening.

C. Use full-size units without cutting if possible. If cutting is required to provide a continuous pattern or to fit adjoining construction, cut units with motor-driven saws; provide clean, sharp, unchipped edges. Allow units to dry before laying unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.

3.3 TOLERANCES

A. Dimensions and Locations of Elements:

1. For dimensions in cross section or elevation, do not vary by more than plus 1/2 inchor minus 1/4 inch.
2. For location of elements in plan, do not vary from that indicated by more than plus or minus 1/2 inch.
3. For location of elements in elevation, do not vary from that indicated by more than plus or minus 1/4 inch in a story height or 1/2 inch total.

B. Lines and Levels:

1. For bed joints and top surfaces of bearing walls, do not vary from level by more than 1/4 inch in 10 feet, or 1/2-inch maximum.
2. For conspicuous horizontal lines, such as lintels, sills, parapets, and reveals, do not vary from level by more than 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2-inch maximum.
3. For vertical lines and surfaces do not vary from plumb by more than 1/4 inch in 10 feet, 3/8 inch in 20 feet, or 1/2-inch maximum.
4. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2-inch maximum.
5. For lines and surfaces, do not vary from straight by more than 1/4 inch in 10 feet, 3/8 inch in 20 feet, or 1/2-inch maximum.
6. For vertical alignment of exposed head joints, do not vary from plumb by more than 1/4 inch in 10 feet, or 1/2-inch maximum.
7. For faces of adjacent exposed masonry units, do not vary from flush alignment by more than 1/16 inch.

C. Joints:

1. For bed joints, do not vary from thickness indicated by more than plus or minus 1/8 inch, with a maximum thickness limited to 1/2 inch.
2. For exposed bed joints, do not vary from bed-joint thickness of adjacent courses by more than 1/8 inch.
3. For head and collar joints, do not vary from thickness indicated by more than plus 3/8 inchor minus 1/4 inch.
4. For exposed head joints, do not vary from thickness indicated by more than plus or minus 1/8 inch.

3.4 LAYING MASONRY WALLS

A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets. Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.

B. Bond Pattern for Exposed Masonry: Unless otherwise indicated, lay exposed masonry in running bond; do not use units with less-than-nominal 4-inch horizontal face dimensions at corners or jambs.

C. Built-in Work: As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry around built-in items.

D. Fill space between steel frames and masonry solidly with mortar unless otherwise indicated.

E. Where built-in items are to be embedded in cores of hollow masonry units, place a layer of metal lath, wire mesh, or plastic mesh in the joint below, and rod mortar or grout into core.

F. Fill cores in hollow CMUs with grout 24 inches under bearing plates, beams, lintels, posts, and similar items unless otherwise indicated.

1. Install compressible filler in joint between top of partition and underside of structure above.
2. Fasten partition top anchors to structure above. Install in accordance with details on Drawings.
3. At fire-rated partitions, treat joint between top of partition and underside of structure above to comply with Section 078413 "Penetration Firestopping."

3.5 MORTAR BEDDING AND JOINTING

A. Lay hollow CMUs as follows:

1. Bed face shells in mortar and make head joints of depth equal to bed joints.
2. Bed webs in mortar in all courses of piers, columns, and pilasters.
3. Bed webs in mortar in grouted masonry, including starting course on footings.
4. Fully bed entire units, including areas under cells, at starting course on footings where cells are not grouted.

B. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness unless otherwise indicated.

C. Cut joints flush for masonry walls to receive plaster or other direct-applied finishes (other than paint) unless otherwise indicated.

D. Cut joints flush where indicated to receive waterproofing unless otherwise indicated.

3.6 MASONRY-JOINT REINFORCEMENT

A. General: Install entire length of longitudinal side rods in mortar with a minimum cover of 5/8 inch on exterior side of walls, 1/2 inch elsewhere. Lap reinforcement a minimum of 6 inches.

1. Space reinforcement not more than 16 inches o.c.
2. Space reinforcement not more than 8 inches o.c. in foundation walls.
3. Provide reinforcement not more than 8 inches above and below wall openings and extending 12 inches beyond openings.

B. Interrupt joint reinforcement at control and expansion joints unless otherwise indicated.

C. Provide continuity at wall intersections by using prefabricated T-shaped units.

D. Provide continuity at corners by using prefabricated L-shaped units.

E. Cut and bend reinforcing units as directed by manufacturer for continuity at corners, returns, offsets, column fireproofing, pipe enclosures, and other special conditions.

3.7 ANCHORING MASONRY TO STRUCTURAL STEEL AND CONCRETE

A. Anchor masonry to structural steel and concrete, where masonry abuts or faces structural steel or concrete, to comply with the following:

1. Provide an open space not less than 1/2 inch wide between masonry and structural steel or concrete unless otherwise indicated. Keep open space free of mortar and other rigid materials.

2. Anchor masonry with anchors embedded in masonry joints and attached to structure.
3. Space anchors as indicated, but not more than 24 inches o.c. vertically and 36 inches o.c. horizontally.

3.8 CONTROL AND EXPANSION JOINTS

A. General: Install control- and expansion-joint materials in unit masonry as masonry progresses. Do not allow materials to span control and expansion joints without provision to allow for in-plane wall or partition movement.

B. Form control joints in concrete masonry as follows:

1. Install temporary foam-plastic filler in head joints, and remove filler when unit masonry is complete for application of sealant.
2. Place control joints such that the panel length to height ratio does not exceed 1.5 and that the maximum panel length does not exceed 25 feet. Additional joints shall be placed where abrupt changes in wall section occur.

3.9 LINTELS

A. Provide masonry lintels where shown and where openings of more than 24 inches are shown without structural steel or other supporting lintels.

B. Provide minimum bearing of 8 inches at each jamb unless otherwise indicated.

3.10 REINFORCED UNIT MASONRY INSTALLATION

A. Temporary Formwork and Shores: Construct formwork and shores as needed to support reinforced masonry elements during construction.

1. Construct formwork to provide shape, line, and dimensions of completed masonry as indicated. Make forms sufficiently tight to prevent leakage of mortar and grout. Brace, tie, and support forms to maintain position and shape during construction and curing of reinforced masonry.
2. Do not remove forms and shores until reinforced masonry members have hardened sufficiently to carry their own weight and other loads that may be placed on them during construction.

B. Placing Reinforcement: Comply with requirements in TMS 602/ACI 530.1/ASCE 6.

C. Grouting: Do not place grout until entire height of masonry to be grouted has attained enough strength to resist grout pressure.

1. Comply with requirements in TMS 602/ACI 530.1/ASCE 6 for cleanouts and for grout placement, including minimum grout space and maximum pour height.
2. Limit height of vertical grout pours to not more than 60 inches.

3.11 FIELD QUALITY CONTROL

A. Testing and Inspecting: Owner will engage special inspectors to perform tests and inspections and prepare reports. Allow inspectors access to scaffolding and work areas as needed to perform tests and inspections. Retesting of materials that fail to comply with specified requirements shall be done at Contractor's expense.

B. Inspections: Special inspections according to Level B in TMS 402/ACI 530/ASCE 5.

1. Begin masonry construction only after inspectors have verified proportions of site-prepared mortar.
2. Place grout only after inspectors have verified compliance of grout spaces and of grades, sizes, and locations of reinforcement.
3. Place grout only after inspectors have verified proportions of site-prepared grout.

C. Testing Prior to Construction: One set of tests.

D. Testing Frequency: One set of tests for each 5000 sq. ft. of wall area or portion thereof.

E. Concrete Masonry Unit Test: For each type of unit provided, according to ASTM C 140 for compressive strength.

F. Mortar Aggregate Ratio Test (Proportion Specification): For each mix provided, according to ASTM C 780.

G. Mortar Test (Property Specification): For each mix provided, according to ASTM C 780. Test mortar for compressive strength.

H. Grout Test (Compressive Strength): For each mix provided, according to ASTM C 1019.

I. Prism Test: For each type of construction provided, according to ASTM C 1314 at 28 days.

3.12 REPAIRING, POINTING, AND CLEANING

A. Remove and replace masonry units that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Install new units to match adjoining units; install in fresh mortar, pointed to eliminate evidence of replacement.

B. Pointing: During the tooling of joints, enlarge voids and holes, except weep holes, and completely fill with mortar. Point up joints, including corners, openings, and adjacent construction, to provide a neat, uniform appearance. Prepare joints for sealant application, where indicated.

C. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.

D. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:

1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
2. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes. Obtain Architect's approval of sample cleaning before proceeding with cleaning of masonry.
3. Protect adjacent surfaces from contact with cleaner.
4. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing surfaces thoroughly with clear water.
5. Clean concrete masonry by applicable cleaning methods indicated in NCMA TEK 8-4A.

3.13 MASONRY WASTE DISPOSAL

A. Salvageable Materials: Unless otherwise indicated, excess masonry materials are Contractor's property. At completion of unit masonry work, remove from Project site.

END OF SECTION 042200

SECTION 054000 - COLD-FORMED METAL FRAMING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Cold-formed metal framing for the following applications:

1. Exterior non-load-bearing wall framing.
2. Interior non-load-bearing wall framing exceeding height limitations of standard, nonstructural metal framing.

B. Related Requirements:

1. Section 055000 "Metal Fabrications" for miscellaneous steel shapes, masonry shelf angles, and connections used with cold-formed metal framing.
2. Section 092216 "Non-Structural Metal Framing" for standard, interior non-load-bearing, metal-stud framing, with height limitations and ceiling-suspension assemblies.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Sealed by the Professional Engineer responsible for their creation and registered in the State of Texas.

1. Include layout, spacings, sizes, thicknesses, and types of cold-formed steel framing; fabrication; and fastening and anchorage details, including mechanical fasteners.
2. Indicate reinforcing channels, opening framing, supplemental framing, strapping, bracing, bridging, splices, accessories, connection details, and attachment to adjoining work.
3. Shop drawings shall be fully coordinated with supporting structural steel and masonry construction, and with curtain wall, storefront, window, and door elements supported by the cold formed metal framing.

1.4 INFORMATIONAL SUBMITTALS

A. Structural Calculations: For information only; calculations sealed by the Professional Engineer responsible for their creation and registered in the State of Texas, indicating compliance with specified performance requirements.

B. Qualification Data: For testing agency.

C. Welding certificates.

D. Product Certificates: For each type of code-compliance certification for studs and tracks.

E. Product Test Reports: For each listed product, from a qualified testing agency.

1. Steel sheet.

2. Expansion anchors.
3. Mechanical fasteners.
4. Vertical deflection clips.

1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: Qualified according to ASTM E329 for testing indicated.

B. Product Tests: Mill certificates or data from a qualified independent testing agency indicating steel sheet complies with requirements, including base-metal thickness, yield strength, tensile strength, total elongation, chemical requirements, and metallic-coating thickness.

C. Code-Compliance Certification of Studs and Tracks: Provide documentation that framing members are certified according to the product-certification program of the Certified Steel Stud Association, the Steel Framing Industry Association or the Steel Stud Manufacturers Association.

D. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
2. AWS D1.3/D1.3M, "Structural Welding Code - Sheet Steel."

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Products: Subject to compliance with requirements, provide products by one of the following:

1. CEMCO, www.cemcosteel.com.
2. ClarkDietrich Metal Framing; www.clarkdietrich.com.
3. MarinoWare; www.marinoware.com.
4. SCAFCO Corporation; www.scafco.com.

2.2 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design cold-formed steel framing.

B. Structural Performance: Provide cold-formed steel framing capable of withstanding design loads within limits and under conditions indicated.

1. Design Loads: As indicated on Drawings.
2. Design exterior non-load-bearing wall framing to withstand design loads without horizontal deflections greater than 1/600 for walls with masonry, stone, or plaster finishes, and 1/360 for walls with other finishes.
3. Design interior non-load-bearing wall framing to withstand a horizontal load of 5 lbs/sq ft without deflections greater than l/240 for walls with gypsum board finishes, and l/360 for walls with tile, stone, or plaster finishes.
4. Design framing systems to provide for movement of framing members located outside the insulated building envelope without damage or overstressing, sheathing failure, connection failure, undue strain on fasteners and anchors, or other detrimental effects when subject to a maximum ambient temperature change of 120 deg F.

5. Design framing system to maintain clearances at openings, to allow for construction tolerances, and to accommodate live load deflection of primary building structure as follows:
   a. Upward and downward movement of l/300.

6. Design exterior non-load-bearing wall framing to accommodate horizontal deflection without regard for contribution of sheathing materials.

C. Cold-Formed Steel Framing Standards: Unless more stringent requirements are indicated, framing shall comply with AISI S100, AISI S200, and the following:

1. Wall Studs: AISI S211.
2. Headers: AISI S212.
3. Lateral Design: AISI S213.

D. Fire-Resistance Ratings: Where metal framing is a part of a fire rated assembly, comply with ASTM E119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Indicate design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency acceptable to authorities having jurisdiction.

2.3 COLD-FORMED STEEL FRAMING MATERIALS

A. Steel Sheet: ASTM A1003, Structural Grade, Type H, metallic coated, Grade ST33H; or ASTM A653, Grade 33, unless higher grade is required to meet performance requirements.

1. Coating: G90.

2.4 EXTERIOR NON-LOAD-BEARING WALL FRAMING

A. Steel Studs: Manufacturer's standard C-shaped steel studs, of web depths indicated, punched, with stiffened flanges, and as follows:

1. Minimum Base-Metal Thickness: 0.0538 inch (16 gage), unless greater thickness is required to meet performance criteria.
2. Flange Width: 1-5/8 inches

B. Steel Track: Manufacturer's standard U-shaped steel track, of web depths indicated, unpunched, with unstiffened flanges, and as follows:

1. Minimum Base-Metal Thickness: Matching steel studs.
2. Flange Width: 1-1/4 inches.

C. Vertical Deflection Clips: Manufacturer's standard bypass or head clips as required to meet design conditions, capable of accommodating upward and downward vertical displacement of primary structure through positive mechanical attachment to stud web.

D. Single Deflection Track: Manufacturer's single, deep-leg, U-shaped steel track; unpunched, with unstiffened flanges, of web depth to contain studs while allowing free vertical movement, with flanges designed to support horizontal loads and transfer them to the primary structure, and as follows:

1. Minimum Base-Metal Thickness: 0.0538 inch (16 gage).
2. Flange Width: 1 inchplus the design gap for one-story structures and 1 inchplus twice the design gap for other applications.

2.5 INTERIOR NON-LOAD-BEARING WALL FRAMING

A. Steel Studs: Manufacturer's standard C-shaped steel studs, of web depths indicated, punched, with stiffened flanges, and as follows:

1. Minimum Base-Metal Thickness: 0.0329 inch (20 gage).
2. Flange Width: 1-3/8 inches.

B. Steel Track: Manufacturer's standard U-shaped steel track, of web depths indicated, unpunched, with unstiffened flanges, and as follows:

1. Minimum Base-Metal Thickness: Matching steel studs.
2. Flange Width: 1-1/4 inches.

C. Single Deflection Track: Manufacturer's single, deep-leg, U-shaped steel track; unpunched, with unstiffened flanges, of web depth to contain studs while allowing free vertical movement, with flanges designed to support horizontal loads and transfer them to the primary structure, and as follows:

1. Minimum Base-Metal Thickness: 0.0329 inch (20 gage).
2. Flange Width: 1 inch plus the design gap for one-story structures and 1 inch plus twice the design gap for other applications.

2.6 FRAMING ACCESSORIES

A. Fabricate steel-framing accessories from same type, grade and coating designation used for framing members.

B. Provide accessories of manufacturer's standard thickness and configuration, unless otherwise indicated, as follows:

1. Supplementary framing.
2. Bracing, bridging, and solid blocking.
3. Web stiffeners.
4. End clips.
5. Gusset plates.
6. Stud kickers and knee braces.
7. Hole-reinforcing plates.
8. Backer plates.

2.7 ANCHORS, CLIPS, AND FASTENERS

A. Steel Shapes and Clips: ASTM A36, zinc coated by hot-dip process according to ASTM A123.

B. Post-Installed Anchors: Fastener systems with bolts of same basic metal as fastened metal, if visible, unless otherwise indicated; with working capacity greater than or equal to the design load, according to an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC01 or ICC-ES AC193 as appropriate for the substrate.

1. Uses: Securing cold-formed steel framing to structure.
2. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B633 or ASTM F1941, Class Fe/Zn 5, unless otherwise indicated.
3. Material for Exterior Locations: Alloy Group 1 stainless-steel bolts, ASTM F593, and nuts, ASTM F594.

C. Mechanical Fasteners: ASTM C1513, corrosion-resistant-coated, self-drilling, self-tapping, steel drill screws.

1. Head Type: Low-profile head beneath sheathing; manufacturer's standard elsewhere.

D. Welding Electrodes: Comply with AWS standards.

2.8 MISCELLANEOUS MATERIALS

A. Galvanizing Repair Paint: ASTM A780, MIL-P-21035B or SSPC-Paint 20.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, conditions, and abutting structural framing for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

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

3.2 PREPARATION

A. Before sprayed fire-resistive materials are applied, attach continuous angles, supplementary framing, or tracks to structural members indicated to receive sprayed fire-resistive materials.

B. After applying sprayed fire-resistive materials, remove only as much of these materials as needed to complete installation of cold-formed framing without reducing thickness of fire-resistive materials below that required to obtain fire-resistance ratings indicated. Protect remaining fire-resistive materials from damage.

3.3 INSTALLATION, GENERAL

A. Install cold-formed steel framing according to AISI S200, AISI S202, and manufacturer's written instructions unless more stringent requirements are indicated.

B. Install cold-formed steel framing and accessories plumb, square, and true to line, and with connections securely fastened.

1. Cut framing members by sawing or shearing; do not torch cut.
2. Fasten cold-formed steel framing members by welding or screw fastening. Wire tying of framing members is not permitted.
   a. Comply with AWS D1.3/D1.3M requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
   b. Locate mechanical fasteners, install according to Shop Drawings, and comply with requirements for spacing, edge distances, and screw penetration.

C. Install framing members in one-piece lengths unless splice connections are indicated for track or tension members.

D. Install temporary bracing and supports to secure framing and support loads equal to those for which structure was designed. Maintain braces and supports in place, undisturbed, until entire integrated supporting structure has been completed and permanent connections to framing are secured.

E. Do not bridge building expansion joints with cold-formed steel framing. Independently frame both sides of joints.

F. Install insulation, specified in Section 072100 "Thermal Insulation," in framing-assembly members, such as headers, sills, boxed joists, and multiple studs at openings, that are inaccessible on completion of framing work.

G. Fasten hole-reinforcing plate over web penetrations that exceed size of manufacturer's approved or standard punched openings.

3.4 EXTERIOR NON-LOAD-BEARING WALL INSTALLATION

A. Install continuous tracks sized to match studs. Align tracks accurately and securely anchor to supporting structure.

B. Fasten both flanges of studs to bottom track unless otherwise indicated. Space studs as indicated on Shop Drawings, but not greater than 16 inches oc.

C. Set studs plumb, except as needed for diagonal bracing or required for nonplumb walls or warped surfaces and similar requirements.

D. Isolate non-load-bearing steel framing from building structure to prevent transfer of vertical loads while providing lateral support.

1. Install single deep-leg deflection tracks and anchor to building structure.
2. Connect vertical deflection clips to bypassing and infill studs and anchor to building structure.

E. Install horizontal bridging in wall studs, spaced vertically in rows indicated on Shop Drawings. Fasten at each stud intersection.

1. Channel Bridging: Cold-rolled steel channel, welded or mechanically fastened to webs of punched studs.
2. Strap Bridging: Combination of flat, taut, steel sheet straps of width and thickness indicated and stud-track solid blocking of width and thickness to match studs. Fasten flat straps to stud flanges and secure solid blocking to stud webs or flanges.
3. Bar Bridging: Proprietary bridging bars installed according to manufacturer's written instructions.

F. Top Bridging for Single Deflection Track: Unless indicated otherwise on Shop Drawings, install row of horizontal bridging within 12 inches of single deflection track. Install a combination of bridging and stud or stud-track solid blocking of width and thickness matching studs, secured to stud webs or flanges.

G. Install miscellaneous framing and connections, including stud kickers, web stiffeners, clip angles, continuous angles, anchors, and fasteners, to provide a complete and stable wall-framing system.

3.5 INTERIOR NON-LOAD-BEARING WALL INSTALLATION

A. Install continuous tracks sized to match studs. Align tracks accurately and securely anchor to supporting structure.

B. Fasten both flanges of studs to bottom track unless otherwise indicated. Space studs as follows:

1. Stud Spacing: As indicated on Drawings, but not greater than 16 inches oc.

C. Set studs plumb, except as needed for diagonal bracing or required for nonplumb walls or warped surfaces and similar requirements.

D. Isolate non-load-bearing steel framing from building structure to prevent transfer of vertical loads while providing lateral support.

1. Install single deep-leg deflection tracks and anchor to building structure.

E. Top Bridging for Single Deflection Track: Install row of horizontal bridging within 12 inches of single deflection track.

F. Install horizontal bridging where indicated on Drawings

G. Install miscellaneous framing and connections, including stud kickers, web stiffeners, clip angles, continuous angles, anchors, and fasteners, to provide a complete and stable wall-framing system.

3.6 ERECTION TOLERANCES

A. Install cold-formed steel framing level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet and as follows:

1. Space individual framing members no more than plus or minus 1/8 inch from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.

3.7 FIELD QUALITY CONTROL

A. Testing: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.

B. Field and shop welds will be subject to testing and inspecting.

C. Testing agency will report test results promptly and in writing to Contractor and Architect.

D. Cold-formed steel framing will be considered defective if it does not pass tests and inspections.

E. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.8 REPAIRS AND PROTECTION

A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on fabricated and installed cold-formed steel framing with galvanized repair paint according to ASTM A780/A780M and manufacturer's written instructions.

B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that cold-formed steel framing is without damage or deterioration at time of Substantial Completion.

END OF SECTION 054000

SECTION 055000 - METAL FABRICATIONS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Steel framing and supports for overhead doors and grilles.
2. Steel framing and supports for countertops.
3. Steel framing and supports for applications where framing and supports are not specified in other Sections.
4. Metal ladders.
5. Metal bollards.

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

1. Loose steel lintels.

1.2 ACTION SUBMITTALS

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

B. Delegated-Design Submittal: For items accompanied with design criteria or performance requirements, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements."

B. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on exterior metal fabrications by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects.

1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

2.2 METALS

A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For metal fabrications exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.

B. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.

C. Steel Tubing: ASTM A 500/A 500M, cold-formed steel tubing.

D. Steel Pipe: ASTM A 53/A 53M, Standard Weight unless otherwise indicated.

2.3 FASTENERS

A. General: Unless otherwise indicated, provide Type 304 stainless-steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B 633 or ASTM F 1941, Class Fe/Zn 5, at exterior walls. Select fasteners for type, grade, and class required.

B. Cast-in-Place Anchors in Concrete: Either threaded type or wedge type unless otherwise indicated; galvanized ferrous castings, either ASTM A 47/A 47M malleable iron or ASTM A 27/A 27M cast steel. Provide bolts, washers, and shims as needed, all hot-dip galvanized per ASTM F 2329.

C. Post-Installed Anchors: Torque-controlled expansion anchors or chemical anchors.

1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B 633 or ASTM F 1941 Class Fe/Zn 5, unless otherwise indicated.
2. Material for Exterior Locations and Where Stainless Steel Is Indicated: Alloy Group 1 stainless-steel bolts, ASTM F 593, and nuts, ASTM F 594.

2.4 MISCELLANEOUS MATERIALS

A. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat.

B. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.

C. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187/D 1187M.

D. Concrete: Comply with requirements in Section 033000 "Cast-in-Place Concrete" for normal-weight, air-entrained, concrete with a minimum 28-day compressive strength of 3000 psi.

2.5 FABRICATION, GENERAL

A. Shop Assembly: Preassemble items in the shop to greatest extent possible. Use connections that maintain structural value of joined pieces.

B. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges. Remove sharp or rough areas on exposed surfaces.

C. Weld corners and seams continuously to comply with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. At exposed connections, finish exposed welds and surfaces smooth and blended.

D. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners or welds where possible. Locate joints where least conspicuous.

E. Fabricate seams and other connections that are exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.

F. Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors not less than 8 inches from ends and corners of units and 24 inches o.c.

2.6 MISCELLANEOUS FRAMING AND SUPPORTS

A. General: Provide steel framing and supports not specified in other Sections as needed to complete the Work.

B. Fabricate units from steel shapes, plates, and bars of welded construction unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction.

2.7 METAL LADDERS

A. General:

1. Comply with ANSI A14.3.
2. For elevator pit ladders, comply with ASME A17.1/CSA B44.

B. Steel Ladders:

1. Space siderails 18 inches apart unless otherwise indicated.
2. Siderails: Continuous, 1/2-by-2-1/2-inch steel flat bars, with eased edges.
3. Rungs: 3/4-inch- diameter steel bars.
4. Fit rungs in centerline of siderails; plug-weld and grind smooth on outer rail faces.
5. Provide nonslip surfaces on top of each rung by coating with abrasive material metallically bonded to rung.
6. Support each ladder at top and bottom and not more than 60 inches o.c. with welded or bolted steel brackets.
7. Provide platforms as indicated, fabricated from welded or pressure-locked steel bar grating, supported by steel angles. Limit openings in gratings to no more than 1/2 inch in least dimension.
8. Galvanize exterior ladders, including brackets.
9. Prime interior ladders, including brackets and fasteners, with universal primer.

2.8 METAL BOLLARDS

A. Fabricate metal bollards from Schedule 40 steel pipe.

B. Fabricate sleeves for removable bollards from Schedule 40 steel pipe or 1/4-inch wall thickness steel tubing with inside diameter approximately 1/8 inch larger than outside diameter of bollards. Match drill sleeve and bollard for 3/4 inch steel machine bolt.

C. Fabricate surface-mounted bollards with 3/8 inch thick steel baseplates for bolting to concrete slab. Drill baseplates at all four corners for 3/4 inch anchor bolts.

1. Where bollards are to be anchored to sloping concrete slabs, angle baseplates for plumb alignment of bollards.

D. Galvanize bollards.

2.9 LOOSE STEEL LINTELS

A. Fabricate loose steel lintels from steel angles and shapes of size indicated for openings and recesses in masonry walls and partitions at locations indicated.

B. Galvanize loose steel lintels.

2.10 FINISHES, GENERAL

A. Finish metal fabrications after assembly.

2.11 STEEL AND IRON FINISHES

A. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A 153/A 153M for steel and iron hardware and with ASTM A 123/A 123M for other steel and iron products.

B. Shop prime iron and steel items not indicated to be galvanized unless they are to be embedded in concrete, sprayed-on fireproofing, or masonry, or unless otherwise indicated.

1. Shop prime with universal shop primer.

C. Preparation for Shop Priming: Prepare surfaces to comply with SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning" and the following:

1. Galvanized-Steel Items: SSPC-SP 16, "Brush-off Blast Cleaning of Coated and Uncoated Galvanized Steel, Stainless Steels, and Non-Ferrous Metals."

D. Shop Priming: Apply shop primer to comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.

B. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.

C. Field Welding: Comply with the following requirements:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

D. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction.

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

3.2 INSTALLING MISCELLANEOUS FRAMING AND SUPPORTS

A. General: Install framing and supports to comply with requirements of items being supported, including manufacturers' written instructions and requirements indicated on Shop Drawings.

B. Anchor miscellaneous supports securely to, and rigidly brace from, building structure.

3.3 INSTALLING METAL BOLLARDS

A. Fill metal-capped bollards solidly with concrete and allow concrete to cure seven days before installing.

1. Do not fill removable bollards with concrete.

B. Anchor bollards in concrete in formed or core-drilled holes. Center and align bollards in holes 3 inches above bottom of excavation. Place concrete and vibrate or tamp for consolidation. Support and brace bollards in position until concrete has cured.

C. Anchor sleeves for removable bollards in formed or core-drilled holes. Center and align sleeves in holes 3 inches above bottom of excavation. Place concrete and vibrate or tamp for consolidation. Support and brace sleeves in position until concrete has cured.

D. Place removable bollards in sleeves and secure with 3/4 inch machine bolts and nuts. After tightening nuts, drill holes in bolts for inserting padlocks. Owner furnishes padlocks.

E. Fill bollards solidly with concrete, mounding top surface to shed water.

1. Do not fill removable bollards with concrete.

3.4 ADJUSTING AND CLEANING

A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas. Touchup uncoated and abraded areas with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.

1. Apply by brush or spray to provide a minimum 2.0-mil dry film thickness.

B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780/A 780M.

END OF SECTION 055000

SECTION 055213 - PIPE AND TUBE RAILINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Steel pipe and tube railings.

1.2 COORDINATION

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.

B. Coordinate installation of anchorages for railings. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

C. Schedule installation so wall attachments are made only to completed walls. Do not support railings temporarily by any means that do not satisfy structural performance requirements.

1.3 ACTION SUBMITTALS

A. Product Data: For the following:

1. Manufacturer's product lines of mechanically connected railings.
2. Railing brackets.
3. Grout, anchoring cement, and paint products.

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

C. Samples: For each type of exposed finish required.

1. Sections of each distinctly different linear railing member, including handrails, top rails, posts, and balusters.
2. Fittings and brackets.
3. Assembled Sample of railing system, made from full-size components, including top rail, post, handrail, and infill. Sample need not be full height.
   a. Show method of connecting and finishing members at intersections.

D. Delegated-Design Submittal: For railings, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For testing agency.

B. Welding certificates.

C. Mill Certificates: Signed by manufacturers of stainless-steel products certifying that products furnished comply with requirements.

D. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers certifying that shop primers are compatible with topcoats.

E. Product Test Reports: For pipe and tube railings, for tests performed by a qualified testing agency, according to ASTM E 894 and ASTM E 935.

F. Evaluation Reports: For post-installed anchors, from ICC-ES.

1.5 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."

1.6 FIELD CONDITIONS

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

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain each type of railing from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design railings, including attachment to building construction.

B. Structural Performance: Railings, including attachment to building construction, shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:

1. Handrails and Top Rails of Guards:
   a. Uniform load of 50 lbf/ ft. applied in any direction.
   b. Concentrated load of 200 lbf applied in any direction.
   c. Uniform and concentrated loads need not be assumed to act concurrently.

2. Infill of Guards:
   a. Concentrated load of 50 lbf applied horizontally on an area of 1 sq. ft..
   b. Infill load and other loads need not be assumed to act concurrently.

C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.

1. Temperature Change: 120 deg F, ambient; 180 deg F.

2.3 METALS, GENERAL

A. Metal Surfaces, General: Provide materials with smooth surfaces, without seam marks, roller marks, rolled trade names, stains, discolorations, or blemishes.

B. Brackets, Flanges, and Anchors: Cast or formed metal of same type of material and finish as supported rails unless otherwise indicated.

1. Provide type of bracket with flange tapped for concealed anchorage to threaded hanger bolt and that provides 1-1/2-inch clearance from inside face of handrail to finished wall surface.

2.4 STEEL AND IRON

A. Tubing: ASTM A 500 (cold formed) or ASTM A 513.

B. Pipe: ASTM A 53/A 53M, Type F or Type S, Grade A, Standard Weight (Schedule 40), unless another grade and weight are required by structural loads.

1. Provide galvanized finish for exterior installations and where indicated.

C. Plates, Shapes, and Bars: ASTM A 36/A 36M.

D. Mesh Infill: Stainless steel sheet or mesh, as indicated on Drawings.

2.5 FASTENERS

A. General: Provide the following:

1. Ungalvanized-Steel Railings: Plated steel fasteners complying with ASTM B 633 or ASTM F 1941, Class Fe/Zn 5 for zinc coating.
2. Provide exposed fasteners with finish matching appearance, including color and texture, of railings.

B. Fasteners for Anchoring Railings to Other Construction: Select fasteners of type, grade, and class required to produce connections suitable for anchoring railings to other types of construction indicated and capable of withstanding design loads.

C. Fasteners for Interconnecting Railing Components:

1. Provide concealed fasteners for interconnecting railing components and for attaching them to other work, unless otherwise indicated.
2. Provide concealed fasteners for interconnecting railing components and for attaching them to other work, unless exposed fasteners are unavoidable or are the standard fastening method for railings indicated.
3. Provide tamper-resistant flat-head machine screws for exposed fasteners unless otherwise indicated.

D. Post-Installed Anchors: Torque-controlled expansion anchors or chemical anchors capable of sustaining, without failure, a load equal to 6 times the load imposed when installed in unit masonry and 4 times the load imposed when installed in concrete, as determined by testing according to ASTM E 488/E 488M, conducted by a qualified independent testing agency.

1. Material for Interior Locations: Carbon-steel components zinc-plated to comply with ASTM B 633 or ASTM F 1941, Class Fe/Zn 5, unless otherwise indicated.

2.6 MISCELLANEOUS MATERIALS

A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.

B. Galvanizing Repair Paint: High-zinc-dust-content paint, complying with SSPC-Paint 20 and compatible with paints specified to be used over it.

C. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat.

D. Shop Primer for Galvanized Steel: Primer formulated for exterior use over zinc-coated metal and compatible with finish paint systems indicated.

E. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107/C 1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.

F. Anchoring Cement: Factory-packaged, nonshrink, nonstaining, hydraulic-controlled expansion cement formulation for mixing with water at Project site to create pourable anchoring, patching, and grouting compound.

1. Water-Resistant Product: At exterior locations provide formulation that is resistant to erosion from water exposure without needing protection by a sealer or waterproof coating and that is recommended by manufacturer for exterior use.

2.7 FABRICATION

A. General: Fabricate railings to comply with requirements indicated for design, dimensions, member sizes and spacing, details, finish, and anchorage, but not less than that required to support structural loads.

B. Shop assemble railings 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. Use connections that maintain structural value of joined pieces.

C. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

D. Form work true to line and level with accurate angles and surfaces.

E. Fabricate connections that are exposed to weather in a manner that excludes water. Provide weep holes where water may accumulate.

F. Cut, reinforce, drill, and tap as indicated to receive finish hardware, screws, and similar items.

G. Connections: Fabricate railings with welded connections unless otherwise indicated.

H. Welded Connections: Cope components at connections to provide close fit, or use fittings designed for this purpose. Weld all around at connections, including at fittings.

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 flux immediately.
4. At exposed connections, finish exposed surfaces smooth and blended so no roughness shows after finishing and welded surface matches contours of adjoining surfaces.

I. Form Changes in Direction as Follows:

1. By radius bends of radius indicated.

J. For changes in direction made by bending, use jigs to produce uniform curvature for each repetitive configuration required. Maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.

K. Close exposed ends of railing members with prefabricated end fittings.

L. Provide wall returns at ends of wall-mounted handrails unless otherwise indicated. Close ends of returns unless clearance between end of rail and wall is 1/4 inch or less.

M. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, flanges, miscellaneous fittings, and anchors to interconnect railing members to other work unless otherwise indicated.

1. At brackets and fittings fastened to plaster or gypsum board partitions, provide crush-resistant fillers or other means to transfer loads through wall finishes to structural supports and prevent bracket or fitting rotation and crushing of substrate.

N. Provide inserts and other anchorage devices for connecting railings to concrete or masonry work. Fabricate anchorage devices capable of withstanding loads imposed by railings. Coordinate anchorage devices with supporting structure.

O. For railing posts set in concrete, provide stainless-steel sleeves not less than 6 inches long with inside dimensions not less than 1/2 inch greater than outside dimensions of post, with metal plate forming bottom closure.

P. For removable railing posts, fabricate slip-fit sockets from stainless-steel tube or pipe whose ID is sized for a close fit with posts; limit movement of post without lateral load, measured at top, to not more than one-fortieth of post height. Provide socket covers designed and fabricated to resist being dislodged.

1. Provide chain with eye, snap hook, and staple across gaps formed by removable railing sections at locations indicated. Fabricate from same metal as railings.

Q. Toe Boards: Where indicated, provide toe boards at railings around openings and at edge of open-sided floors and platforms. Fabricate to dimensions and details indicated.

2.8 STEEL FINISHES

A. Galvanized Railings:

1. Hot-dip galvanize exterior steel railings, including hardware, after fabrication.
2. Comply with ASTM A123/A123M for hot-dip galvanized railings.
3. Comply with ASTM A153/A153M for hot-dip galvanized hardware.
4. Do not quench or apply post-galvanizing treatments that might interfere with paint adhesion.

5. Fill vent and drain holes that are exposed in the finished Work, unless indicated to remain as weep holes, by plugging with zinc solder and filing off smooth.

B. For galvanized railings, provide hot-dip galvanized fittings, brackets, fasteners, sleeves, and other ferrous components.

C. Preparing Galvanized Railings for Shop Priming: After galvanizing, thoroughly clean railings of grease, dirt, oil, flux, and other foreign matter, and treat with etching cleaner and as follows.

1. Comply with SSPC-SP 16.

D. For nongalvanized-steel railings, provide nongalvanized ferrous-metal fittings, brackets, fasteners, and sleeves; however, hot-dip galvanize anchors to be embedded in exterior concrete or masonry.

E. Preparaing Nongalvanized Railings for Shop Priming: Prepare surfaces to comply with SSPC-SP 6/NACE No. 3.

F. Primer Application: Apply shop primer to prepared surfaces of railings unless otherwise indicated. Comply with requirements in SSPC-PA 1 for shop painting. Primer need not be applied to surfaces to be embedded in concrete or masonry.

1. Shop prime nongalvanized railings with universal shop primer unless indicated.
2. Shop prime galvanized railings with shop primer for galvanized steel.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine plaster and gypsum board assemblies, where reinforced to receive anchors, to verify that locations of concealed reinforcements are clearly marked for Installer. Locate reinforcements and mark locations if not already done.

3.2 INSTALLATION, GENERAL

A. Fit exposed connections together to form tight, hairline joints.

B. Perform cutting, drilling, and fitting required for installing railings. Set railings accurately in location, alignment, and elevation; measured from established lines and levels and free of rack.

1. Do not weld, cut, or abrade surfaces of railing components that are coated or finished after fabrication and that are intended for field connection by mechanical or other means without further cutting or fitting.
2. Set posts plumb within a tolerance of 1/16 inch in 3 feet.
3. Align rails so variations from level for horizontal members and variations from parallel with rake of steps and ramps for sloping members do not exceed 1/4 inch in 12 feet.

C. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.

1. Coat, with a heavy coat of bituminous paint, concealed surfaces of aluminum that are in contact with grout, concrete, masonry, wood, or dissimilar metals.

D. Adjust railings before anchoring to ensure matching alignment at abutting joints.

E. Fastening to In-Place Construction: Use anchorage devices and fasteners where necessary for securing railings and for properly transferring loads to in-place construction.

3.3 RAILING CONNECTIONS

A. Welded Connections: Use fully welded joints for permanently connecting railing components. Comply with requirements for welded connections in "Fabrication" Article whether welding is performed in the shop or in the field.

B. Expansion Joints: Install expansion joints at locations indicated but not farther apart than required to accommodate thermal movement. Provide slip-joint internal sleeve extending 2 inches beyond joint on either side, fasten internal sleeve securely to one side, and locate joint within 6 inches of post.

3.4 ANCHORING POSTS

A. Form or core-drill holes not less than 5 inches deep and 3/4 inch larger than OD of post for installing posts in concrete. Clean holes of loose material, insert posts, and fill annular space between post and concrete with nonshrink, nonmetallic grout or anchoring cement, mixed and placed to comply with anchoring material manufacturer's written instructions.

B. Cover anchorage joint with flange of same metal as post, welded to post after placing anchoring material.

C. Anchor posts to metal surfaces with oval flanges, angle type, or floor type as required by conditions, connected to posts and to metal supporting members as follows:

1. For aluminum pipe railings, attach posts using fittings designed and engineered for this purpose.
2. For stainless-steel pipe railings, weld flanges to post and bolt to supporting surfaces.
3. For steel pipe railings, weld flanges to post and bolt to metal supporting surfaces.

D. Install removable railing sections, where indicated, in slip-fit metal sockets cast in concrete.

3.5 ATTACHING RAILINGS

A. Anchor railing ends at walls with round flanges anchored to wall construction and welded to railing ends.

B. Anchor railing ends to metal surfaces with flanges bolted to metal surfaces and welded to railing ends.

C. Attach railings to wall with wall brackets, except where end flanges are used. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads.

D. Secure wall brackets and railing end flanges to building construction as follows:

1. For concrete and solid masonry anchorage, use drilled-in expansion shields and hanger or lag bolts.
2. For hollow masonry anchorage, use toggle bolts.
3. For steel-framed partitions, use toggle bolts installed through flanges of steel framing or through concealed steel reinforcements.

3.6 ADJUSTING AND CLEANING

A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material as used for shop painting to comply with SSPC-PA 1 requirements for touching up shop-painted surfaces.

1. Apply by brush or spray to provide a minimum 2.0-mil dry film thickness.

3.7 PROTECTION

A. Protect finishes of railings from damage during construction period with temporary protective coverings approved by railing manufacturer. Remove protective coverings at time of Substantial Completion.

END OF SECTION

SECTION 055313 - BAR GRATINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes metal bar gratings and metal frames and supports for gratings.

B. Related Requirements:

1. Section 055000 "Metal Fabrications" for structural-steel framing system components.

1.2 COORDINATION

A. Coordinate installation of anchorages for gratings, grating frames, and supports. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

1.3 ACTION SUBMITTALS

A. Product Data: For the following:

1. Clips and anchorage devices for gratings.

B. Shop Drawings: Include plans, sections, details, and attachments to other work.

C. Delegated-Design Submittal: For gratings, including manufacturers' published load tables and analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.4 INFORMATIONAL SUBMITTALS

A. Welding certificates.

1.5 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."

1.6 FIELD CONDITIONS

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

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design gratings.

B. Structural Performance: Gratings shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:

1. Floors: Uniform load of 250 lbf/sq. ft. or concentrated load of 3000 lbf, whichever produces the greater stress.
2. Limit deflection to L/360 or 1/4 inch, whichever is less.

2.2 METAL BAR GRATINGS

A. Metal Bar Grating Standards: Comply with NAAMM MBG 531, "Metal Bar Grating Manual."

B. Welded Steel Grating:

1. Bearing Bar Spacing: 1-3/16 inches o.c.
2. Bearing Bar Depth: 1-3/4 inch.
3. Bearing Bar Thickness: 3/16 inch.
4. Crossbar Spacing: 4 inches o.c.
5. Traffic Surface: Serrated.
6. Steel Finish: Hot-dip galvanized with a coating weight of not less than 1.8 oz./sq. ft. of coated surface.

2.3 FERROUS METALS

A. Steel Plates, Shapes, and Bars: ASTM A36/A36M.

B. Steel Bars for Bar Gratings: ASTM A36/A36M or steel strip, ASTM A1011/A1011M or ASTM A1018/A1018M.

C. Wire Rod for Bar Grating Crossbars: ASTM A510.

D. Uncoated Steel Sheet: ASTM A1011/A1011M, structural steel, Grade 30.

E. Galvanized-Steel Sheet: ASTM A653/A653M, structural quality, Grade 33, with G90 coating.

2.4 FASTENERS

A. General: Unless otherwise indicated, provide Type 316 stainless-steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B633 or ASTM F1941, Class Fe/Zn 5, at exterior walls. Select fasteners for type, grade, and class required.

1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B633 or ASTM F1941, Class Fe/Zn 5, unless otherwise indicated.

2.5 MISCELLANEOUS MATERIALS

A. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.

2.6 FABRICATION

A. Shop Assembly: Fabricate grating sections in shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.

B. Cut, drill, and punch material cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

C. Form from materials of size, thickness, and shapes indicated, but not less than that needed to support indicated loads.

D. Fit exposed connections accurately together to form hairline joints.

E. Welding: Comply with AWS recommendations and 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.

F. Provide for anchorage of type indicated; coordinate with supporting structure. Fabricate and space the anchoring devices to secure gratings, frames, and supports rigidly in place and to support indicated loads.

G. Removable Grating Sections: Fabricate with banding bars attached by welding to entire perimeter of each section. Include anchors and fasteners of type indicated or, if not indicated, as recommended by manufacturer for attaching to supports.

1. Provide no fewer than four saddle clips for each grating section containing rectangular bearing bars 3/16 inch or less in thickness and spaced 15/16 inch or more o.c., with each clip designed and fabricated to fit over two bearing bars.
2. Furnish threaded bolts with nuts and washers for securing grating to supports.
3. Furnish self-drilling fasteners with washers for securing grating to supports.

H. Fabricate cutouts in grating sections for penetrations indicated. Arrange cutouts to permit grating removal without disturbing items penetrating gratings.

1. Edge-band openings in grating that interrupt four or more bearing bars with bars of same size and material as bearing bars.

I. Do not notch bearing bars at supports to maintain elevation.

2.7 GRATING FRAMES AND SUPPORTS

A. Fabricate from metal shapes, plates, and bars of welded construction to sizes, shapes, and profiles indicated and as necessary to receive gratings. Miter and weld connections for perimeter angle frames. Cut, drill, and tap units to receive hardware and similar items.

1. Unless otherwise indicated, fabricate from same basic metal as gratings.
2. Equip units indicated to be cast into concrete or built into masonry with integrally welded anchors. Unless otherwise indicated, space anchors 24 inches o.c. and provide minimum anchor units in the form of steel straps 1-1/4 inches wide by 1/4 inch thick by 8 inches long.

B. Galvanize steel frames and supports.

2.8 STEEL FINISHES

A. Finish gratings, frames, and supports after assembly.

B. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A153/A153M for steel and iron hardware and with ASTM A123/A123M for other steel and iron products.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing gratings to in-place construction. Include threaded fasteners for concrete and masonry inserts, through-bolts, lag bolts, and other connectors.

B. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing gratings. Set units accurately in location, alignment, and elevation; measured from established lines and levels and free of rack.

C. Provide temporary bracing or anchors in formwork for items that are to be built into concrete or masonry.

D. Fit exposed connections accurately together to form hairline joints.

1. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade the surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.

E. Attach toeplates to gratings by welding at locations indicated.

F. Field Welding: Comply with AWS recommendations and 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.

3.2 INSTALLING METAL BAR GRATINGS

A. General: Install gratings to comply with recommendations of referenced metal bar grating standards that apply to grating types and bar sizes indicated, including installation clearances and standard anchoring details.

B. Attach removable units to supporting members with type and size of clips and fasteners indicated or, if not indicated, as recommended by grating manufacturer for type of installation conditions shown.

C. Attach nonremovable units to supporting members by welding where both materials are same; otherwise, fasten by bolting as indicated above.

3.3 ADJUSTING AND CLEANING

A. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A780/A780M.

END OF SECTION 055313

SECTION 061000 - ROUGH CARPENTRY

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Miscellaneous wood framing and blocking.
2. Rooftop cants, nailers, curbs, and equipment bases.
3. Plywood backing panels.

B. Related Requirements:

1. Section 061600 "Sheathing" for plywood parapet sheathing.

1.2 DEFINITIONS

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

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

C. Lumber grading agencies, and the abbreviations used to reference them, include the following:

1. NeLMA: Northeastern Lumber Manufacturers' Association.
2. NLGA: National Lumber Grades Authority.
3. RIS: Redwood Inspection Service.
4. SPIB: The Southern Pine Inspection Bureau.
5. WCLIB: West Coast Lumber Inspection Bureau.
6. WWPA: Western Wood Products Association.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.

1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Indicate type of preservative used and net amount of preservative retained.
2. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Include physical properties of treated materials based on testing by a qualified independent testing agency.
3. For fire-retardant treatments, include physical properties of treated lumber both before and after exposure to elevated temperatures, based on testing by a qualified independent testing agency according to ASTM D 5664.
4. Include copies of warranties from chemical treatment manufacturers for each type of treatment.

1.4 INFORMATIONAL SUBMITTALS

A. Material Certificates: For dimension lumber specified to comply with minimum allowable unit stresses. Indicate species and grade selected for each use and design values approved by the ALSC Board of Review.

B. Evaluation Reports: For the following, from ICC-ES:

1. Wood-preservative-treated wood.
2. Fire-retardant-treated wood.
3. Power-driven fasteners.
4. Powder-actuated fasteners.
5. Expansion anchors.

1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: For testing agency providing classification marking for fire-retardant treated material, an inspection agency acceptable to authorities having jurisdiction that periodically performs inspections to verify that the material bearing the classification marking is representative of the material tested.

1.6 DELIVERY, STORAGE, AND HANDLING

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

PART 2 - PRODUCTS

2.1 WOOD PRODUCTS, GENERAL

A. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, provide lumber that complies with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Provide lumber graded by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.

1. Factory mark each piece of lumber with grade stamp of grading agency.
2. For exposed lumber indicated to receive a stained or natural finish, mark grade stamp on end or back of each piece.
3. Where nominal sizes are indicated, provide actual sizes required by DOC PS 20 for moisture content specified. Where actual sizes are indicated, they are minimum dressed sizes for dry lumber.
4. Provide dressed lumber, S4S, unless otherwise indicated.
5. Maximum Moisture Content of Lumber: 19 percent unless otherwise indicated.

B. Plywood: DOC PS 1 Exposure 1.

1. Thickness: As needed to comply with requirements, but not less than 1/2 inch.
2. Factory mark panels to indicate compliance with applicable standard.
3. Maximum Moisture Content of Plywood: 15 percent unless otherwise indicated.

2.2 FIRE-RETARDANT-TREATED MATERIALS

A. General: Where fire-retardant-treated materials are indicated, use materials complying with requirements in this article, that are acceptable to authorities having jurisdiction, and with fire-test-response characteristics specified as determined by testing identical products per test method indicated by a qualified testing agency.

B. Fire-Retardant-Treated Lumber and Plywood by Pressure Process: Products with a flame spread index of 25 or less when tested according to ASTM E 84, and with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet beyond the centerline of the burners at any time during the test.

1. Use treatment that does not promote corrosion of metal fasteners.
2. Interior Type A: Treated materials shall have a moisture content of 28 percent or less when tested according to ASTM D 3201 at 92 percent relative humidity.
3. Design Value Adjustment Factors: Treated lumber shall be tested according ASTM D 5664 and design value adjustment factors shall be calculated according to ASTM D 6841.

C. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Kiln-dry plywood after treatment to a maximum moisture content of 15 percent.

D. Identify fire-retardant-treated wood with appropriate classification marking of qualified testing agency.

2.3 WOOD-PRESERVATIVE-TREATED LUMBER

A. Preservative Treatment by Pressure Process: AWPA U1; Use Category UC2 for interior construction not in contact with the ground, Use Category UC3b for exterior construction not in contact with the ground, and Use Category UC4a for items in contact with the ground.

1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium. Do not use inorganic boron (SBX) for sill plates.
2. For exposed items indicated to receive a stained or natural finish, use chemical formulations that do not require incising, contain colorants, bleed through, or otherwise adversely affect finishes.

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

C. Mark lumber with treatment quality mark of an inspection agency approved by the ALSC Board of Review.

2.4 MISCELLANEOUS LUMBER

A. General: Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:

1. Miscellaneous framing.
2. Blocking.
3. Rooftop nailers, curbs, and equipment bases.
4. Cants.

B. For items of dimension lumber size, provide Construction or No. 2 grade lumber and the following species:

1. Mixed southern pine; SPIB.
2. Eastern softwoods; NeLMA.

C. For concealed boards, provide lumber with 19 percent maximum moisture content andthe following species and grades:

1. Mixed southern pine; No. 3 grade; SPIB.

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

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

2.5 PLYWOOD BACKING PANELS

A. Equipment Backing Panels: DOC PS 1, Exterior, AC, fire-retardant treated, in thickness indicated or, if not indicated, not less than 3/4-inch nominal thickness.

2.6 FASTENERS

A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.

1. Type: 304 stainless steel, unless otherwise indicated.

B. Nails, Brads, and Staples: ASTM F 1667.

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

D. Wood Screws: ASME B18.6.1.

E. Lag Bolts: ASME B18.2.1.

F. Bolts: Steel bolts complying with ASTM A 307, Grade A; with ASTM A 563 hex nuts and, where indicated, flat washers.

G. Expansion Anchors: Anchor bolt and sleeve assembly of material indicated below with capability to sustain, without failure, a load equal to six times the load imposed when installed in unit masonry assemblies and equal to four times the load imposed when installed in concrete as determined by testing per ASTM E 488 conducted by a qualified independent testing and inspecting agency.

1. Material: Carbon-steel components, zinc plated to comply with ASTM B 633, Class Fe/Zn 5.
2. Material: Stainless steel with bolts and nuts complying with ASTM F 593 and ASTM F 594, Alloy Group 1 or 2.

2.7 MISCELLANEOUS MATERIALS

A. Adhesives for Gluing Furring to Concrete or Masonry: Formulation complying with ASTM D3498 that is approved for use indicated by adhesive manufacturer.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Set rough carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit rough carpentry to other construction; scribe and cope as needed for accurate fit. Locate nailers, blocking, and similar supports to comply with requirements for attaching other construction.

B. Install plywood backing panels by fastening to studs; coordinate locations with utilities requiring backing panels. Install fire-retardant treated plywood backing panels with classification marking of testing agency exposed to view.

C. Provide blocking and framing as indicated and as required to support facing materials, fixtures, specialty items, and trim.

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

E. Comply with AWPA M4 for applying field treatment to cut surfaces of preservative-treated lumber.

1. Use inorganic boron for items that are continuously protected from liquid water.
2. Use copper naphthenate for items not continuously protected from liquid water.

F. Securely attach rough carpentry work to substrate by anchoring and fastening as indicated, complying with the following:

1. Table 2304.9.1, "Fastening Schedule," in ICC's International Building Code.
2. Applicable FM and SPRI ES-1 requirements.

3.2 WOOD FRAMING AND BLOCKING INSTALLATION

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

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

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

3.3 ROOF NAILER INSTALLATION

A. Install wood nailers at perimeter of the entire roof and around such other roof projections and penetrations as specified in accordance with FM DS 1-49 securement requirements.

B. Nailers shall be the same height as the finished height of the insulation layer. Nailers shall be anchored to resist a pull-out force of 175 pounds per foot. Fasteners shall be no less than two (2) per nailer, and be spaced at three (3) feet on center maximum or as required by FM DS 1-49 requirements.

C. Offset ends of stacked nailers a minimum of 6 inches.

3.4 PROTECTION

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

3.5 TREATMENT SCHEDULE

A. Unless indicated otherwise, provide treatment of rough carpentry items as follows:

1. Fire-Retardant Treatment:
   a. All rough carpentry items not indicated to be preservative treated.
      1) Concealed members not required to be fire-retardant treated by the authorities having jurisdiction at the site of the Work may be untreated.

2. Preservative Treatment:
   a. Nailers, cants, curbs, and equipment bases in connection with roofing.
   b. Blocking and nailers in connection with air barriers and waterproofing.

END OF SECTION

SECTION 061600 - SHEATHING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Glass-mat gypsum wall sheathing.
2. Plywood parapet sheathing.

B. Related Sections include the following:

1. Section 054000 “Cold-Formed Metal Framing” for wall and parapet framing.
2. Section 072726 "Air Barriers" for air barrier membrane applied over exterior wall sheathing, including joint treatment.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review air-barrier and glass-mat gypsum sheathing requirements and installation, special details, transitions, mockups, air-leakage testing, protection, and work scheduling that covers air-barrier and glass-mat gypsum sheathing.

1.3 SUBMITTALS

A. Product Data: For each type of sheathing and fastener. Indicate component materials and dimensions and include construction and application details.

1. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated plywood complies with requirements. Include physical properties of treated materials.
2. Include copies of warranties from chemical treatment manufacturers for each type of treatment.

B. Shop Drawings: For air-barrier and glass-mat gypsum sheathing assemblies.

1. Show locations and extent of sheathing, accessories, and assemblies specific to Project conditions.
2. Show sheathing fastening requirements.
3. Include details for sheathing joints and cracks, penetrations, inside and outside corners, terminations, and tie-ins with adjoining construction.
4. Include details of interfaces with other materials that form part of air barrier.

C. Research/Evaluation Reports: For fire-retardant-treated plywood, showing compliance with building code in effect for Project:

1.4 QUALITY ASSURANCE

A. Fire-Test-Response Characteristics: For assemblies with fire-resistance ratings, provide materials and construction identical to those of assemblies tested for fire resistance per ASTM E 119 by a testing and inspecting agency acceptable to authorities having jurisdiction.

1. Fire-Resistance Ratings: Indicated by design designations from UL's "Fire Resistance Directory."

1.5 DELIVERY, STORAGE, AND HANDLING

A. Stack plywood and other panels flat with spacers between each bundle to provide air circulation. Provide for air circulation around stacks and under coverings.

PART 2 - PRODUCTS

2.1 FIRE-RETARDANT-TREATED PLYWOOD

A. Fire-Retardant-Treated Lumber and Plywood by Pressure Process: Products with a flame spread index of 25 or less when tested according to ASTM E 84, and with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet beyond the centerline of the burners at any time during the test.

1. Use treatment that does not promote corrosion of metal fasteners.
2. Interior Type A: Treated materials shall have a moisture content of 28 percent or less when tested according to ASTM D 3201 at 92 percent relative humidity.
3. Design Value Adjustment Factors: Treated lumber shall be tested according ASTM D 5664 and design value adjustment factors shall be calculated according to ASTM D 6841.

B. Kiln-dry plywood after treatment to a maximum moisture content of 15 percent.

C. Identify fire-retardant-treated plywood with appropriate classification marking of qualified testing agency.

2.2 WALL SHEATHING

A. Glass-Mat Gypsum Sheathing: ASTM C 1177/1177M.

1. Product: Subject to compliance with requirements, provide Dens-Glass Exterior Sheathing by Georgia-Pacific Gypsum LLC, or comparable product by one of the following:
   a. CertainTeed.
   b. National Gypsum Company.
   c. USG Corporation.

2. Type and Thickness: Type X, 5/8 inch thick.

2.3 PARAPET SHEATHING

A. Plywood Sheathing: DOC PS 1, Exposure 1, Grade C-D sheathing, fire-retardant treated.

1. Nominal Thickness: As indicated on Drawings but not less than 5/8 inch.

2.4 FASTENERS

A. General: Provide fasteners of size and type indicated that comply with requirements specified in this Article for material and manufacturer.

1. For parapet and wall sheathing, provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M or of Type 304 stainless steel.

B. Screws for Fastening Sheathing to Cold-Formed Metal Framing: Steel drill screws, ASTM C 954, in length recommended by sheathing manufacturer for thickness of sheathing to be attached.

1. For fastening plywood, use screws with wafer heads and reamer wings.

2.5 SHEATHING JOINT-AND-PENETRATION TREATMENT MATERIALS

A. Joint Treatment for Glass-Mat Gypsum Sheathing Board: Refer to Section 072726 "Air Barriers" for joint treatment.

B. Joint Treatment for Plywood Parapet Sheathing: Refer to Division 07 roofing sections for joint treatment.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Do not use materials with defects that impair quality of sheathing or pieces that are too small to use with minimum number of joints or optimum joint arrangement.

B. Cut panels at penetrations, edges, and other obstructions of work; fit tightly against abutting construction, unless otherwise indicated.

C. Securely attach to substrate by fastening as indicated, complying with the following:

1. Table 2304.9.1, "Fastening Schedule," in ICC's "International Building Code."
2. FM Global or SPRI ES-1 requirements.

D. Coordinate sheathing installation with flashing and joint-sealant installation so these materials are installed in sequence and manner that prevent exterior moisture from passing through completed assembly.

E. Do not bridge building expansion joints; cut and space edges of panels to match spacing of structural support elements.

F. Coordinate sheathing installation with installation of materials installed over sheathing so sheathing is not exposed to precipitation or left exposed at end of the workday when rain is forecast.

3.2 SHEATHING INSTALLATION

A. For glass-mat gypsum sheathing, comply with GA-253 and with manufacturer's written instructions.

B. Fasten sheathing to cold-formed metal framing with screws.

C. Install sheathing with a 3/8-inch gap where non-load-bearing construction abuts structural elements.

D. Install sheathing with a 1/4-inch gap where they abut masonry or similar materials that might retain moisture, to prevent wicking.

E. Space plywood sheathing 1/8 inch apart at edges and ends.

F. Abut ends and edges of glass-mat gypsum sheathing.

G. Apply fasteners so heads bear tightly against face of sheathing but do not cut into facing.

H. Horizontal Installation: Install sheathing with ends over centers of studs, and stagger end joints of adjacent panels not less than one stud spacing. Attach at perimeter and within field of panel to each stud.

I. Vertical Installation: Install vertical edges centered over studs. Attach boards at perimeter and within field of board to each stud.

J. Space fasteners approximately 8 inches o.c. and set back a minimum of 3/8 inch from edges and ends of boards.

K. Seal glass-mat gypsum sheathing joints according to Section 072726 "Air Barriers."

L. Seal plywood parapet sheathing joints according to roof membrane manufacturer's instructions.

3.3 FIELD QUALITY CONTROL

A. Owner will engage a qualified testing agency to perform tests and inspections of air barrier construction. Refer to Section 072726 "Air Barriers" for inspecting and field testing of air barrier.

B. Repair damage to sheathing caused by testing; follow manufacturer's written instructions.

END OF SECTION

SECTION 064116 – PLASTIC LAMINATE-FACED ARCHITECTURAL CABINETS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Plastic-laminate-faced architectural cabinets.

B. Related Requirements:

1. Section 061000 "Rough Carpentry" for wood furring, blocking, shims, and hanging strips required for installing cabinets and concealed within other construction before cabinet installation.
2. Section 123661 "Simulated Stone Countertops" for countertops other than plastic laminate.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product, including panel products high-pressure decorative laminate adhesive for bonding plastic laminate and cabinet hardware and accessories.

B. Shop Drawings: Show location of each item, dimensioned plans and elevations, large-scale details, attachment devices, and other components.

1. Show details full size.
2. Show locations and sizes of furring, blocking, and hanging strips, including concealed blocking and reinforcement specified in other Sections.
3. Show locations and sizes of cutouts and holes for electrical switches and outlets and other items installed in architectural plastic-laminate cabinets.
4. Apply AWI Quality Certification Program label to Shop Drawings.

C. Samples for Verification:

1. Plastic laminates, 8 by 10 inches, for each type, color, pattern, and surface finish, with one sample applied to core material and specified edge material applied to one edge.
2. PVC edge material.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For fabricator.

B. Woodwork Quality Standard Compliance Certificates: AWI Quality Certification Program certificates.

1.4 QUALITY ASSURANCE

A. Fabricator Qualifications: Shop that employs skilled workers who custom fabricate products similar to those required for this Project and whose products have a record of successful in-service performance. Shop is a certified participant in AWI's Quality Certification Program.

B. Installer Qualifications: Fabricator of products.

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 typical plastic-laminate cabinets as shown on Drawings.
2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.5 DELIVERY, STORAGE, AND HANDLING

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

1.6 FIELD CONDITIONS

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

B. Field Measurements: Where cabinets are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication, and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1. Locate concealed framing, blocking, and reinforcements that support cabinets by field measurements before being enclosed, and indicate measurements on Shop Drawings.

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

1.7 COORDINATION

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

PART 2 - PRODUCTS

2.1 PLASTIC-LAMINATE-FACED ARCHITECTURAL CABINETS

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

1. Provide labels and certificates from AWI certification program indicating that woodwork, including installation, complies with requirements of grades specified.
2. The Contract Documents contain selections chosen from options in the quality standard and additional requirements beyond those of the quality standard. Comply with those selections and requirements in addition to the quality standard.

B. Grade: AWI Custom.

C. Type of Construction: Frameless.

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

E. High-Pressure Decorative Laminate: NEMA LD 3, grades as indicated or if not indicated, as required by woodwork quality standard.

1. Manufacturers: Subject to compliance with requirements, acceptable manufacturers include the following:
   a. Abet Laminati, Inc.
   b. Arborite
   c. Formica Corporation.
   d. Lamin-Art, Inc.
   e. Nevamar.
   f. Panolam Industries International, Inc.
   g. Wilsonart International.

F. Laminate Cladding for Exposed Surfaces:

1. Horizontal Surfaces: Grade HGL.
2. Postformed Surfaces: Grade HGP.
3. Vertical Surfaces: Grade VGS.
4. Edges: PVC edge banding, 0.12 inch thick, matching laminate in color, pattern, and finish.
5. Pattern Direction: Vertically for drawer fronts, doors, and fixed panels.

G. Materials for Semiexposed Surfaces:

1. Surfaces Other Than Drawer Bodies: High-pressure decorative laminate, NEMA LD 3, Grade VGS.
   a. Edges of Plastic-Laminate Shelves: PVC tape, 0.018-inch minimum thickness, matching laminate in color, pattern, and finish.
   b. For semiexposed backs of panels with exposed plastic-laminate surfaces, provide surface of high-pressure decorative laminate, NEMA LD 3, Grade CLS.
2. Drawer Sides and Backs: Thermoset decorative panels with PVC or polyester edge banding.
3. Drawer Bottoms: Thermoset decorative panels.

H. Dust Panels: 1/4-inch plywood or tempered hardboard above compartments and drawers unless located directly under tops.

I. Concealed Backer Panels for balanced construction of Exposed Plastic-Laminate Surfaces: High-pressure decorative laminate, NEMA LD 3, Grade BKL.

J. Drawer Construction: Fabricate with exposed fronts fastened to subfront with mounting screws from interior of body.

1. Join subfronts, backs, and sides with glued dovetail joints.

K. Colors, Patterns, and Finishes: As indicated on Finish Schedule.

2.2 WOOD MATERIALS

A. Wood Products: Provide materials that comply with requirements of referenced quality standard for each type of woodwork and quality grade specified unless otherwise indicated.

1. Wood Moisture Content: 8 to 13 percent.

B. Composite Wood Products: Provide materials that comply with requirements of referenced quality standard for each type of woodwork and quality grade specified unless otherwise indicated.

1. Particleboard: ANSI A208.1, Grade M-2.
2. Marine Grade Plywood: water resistant treated plywood shall have 24 hour thickness swell factor of five percent or less and 24 hour water absorption factor of ten percent or less; P.S. 51, Type II or better.
3. Thermoset Decorative Panels: Particleboard or medium-density fiberboard finished with thermally fused, melamine-impregnated decorative paper and complying with requirements of NEMA LD 3, Grade VGL, for test methods 3.3, 3.4, 3.6, 3.8, and 3.10.

2.3 CABINET HARDWARE AND ACCESSORIES

A. General: Provide cabinet hardware and accessory materials associated with architectural cabinets except for items specified in Section 087100 "Door Hardware."

B. Frameless Concealed Hinges (European Type): BHMA A156.9, B01602, 100 degrees of opening, self-closing.

C. Drawer and Cabinet Pulls.

1. Manufacturer: Hafele Americana Collection

D. Catches: Push-in magnetic catches, BHMA A156.9, B03131.

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

F. Adjustable Shelf Rests: BHMA B84073, injection molded transparent polycarbonate, friction fit into 5mm diameter predrilled holes. Provide four rests per shelf. Rests automatically adapt to 3/4 inch or 1 inch thick shelving and provide non-tip feature for shelving. Load capacity to 300 pounds per rest without failure.

G. Drawer Slides: BHMA A156.9.

1. Grade 1: Side mounted and extending under bottom edge of drawer; full-extension type; epoxy-coated steel with polymer rollers.
2. Grade 1HD-100 and Grade 1HD-200: Side mounted; full-overtravel-extension type; zinc-plated-steel ball-bearing slides.
3. For drawers not more than 3 inches high and not more than 24 inches wide, provide Grade 1.
4. For drawers more than 3 inches high or more than 24 inches wide, provide Grade 1HD-100; and Grade 1HD-200 at file drawers.
5. For computer keyboard shelves, provide Grade 1.

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

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

J. Digital Locks: Battery operated electronic keypad lock semi-recessed into cabinet door, programmable with key to permit opening with either a preset or user-assignable combination number; with ADA lever and brushed chrome finish.

1. Product: Classic Cam Keypad Lock as manufactured by Digilock; www.digilock.com.

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

L. Grommets for Cable Passage: 2-inch OD, molded-plastic grommets and matching plastic caps with slot for wire passage, black color.

M. Countertop Brackets: Formed steel brackets with integral gussets, minimum 1/8 inch thick x 1-1/2 inches wide with holes for fasteners; 1,000 lb capacity; manufacturer's powder coat finish, color as selected from manufacturer's standard colors.

1. Standard Workstation and Contertop Brackets as manufactured by A&M Hardware, Inc; www.aandmhadware.com.

N. Exposed Hardware Finishes: For exposed hardware, provide finish that complies with BHMA A156.18 for BHMA finish number indicated.

1. Satin Stainless Steel: BHMA 630.

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

2.4 MISCELLANEOUS MATERIALS

A. Furring, Blocking, Shims, and Hanging Strips: Fire-retardant-treated softwood lumber, kiln dried to less than 15 percent moisture content.

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

C. Adhesive for Bonding Plastic Laminate: Resorcinol.

1. Adhesive for Bonding Edges: Hot-melt adhesive.

2.5 FABRICATION

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

B. Complete fabrication, including assembly and hardware application, to maximum extent possible before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.

1. Trial fit assemblies at fabrication shop that cannot be shipped completely assembled. Install dowels, screws, bolted connectors, and other fastening devices that can be removed after trial fitting. Verify that various parts fit as intended and check measurements of assemblies against field measurements before disassembling for shipment.

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

D. Install glass to comply with applicable requirements in Section 088000 "Glazing" and in GANA's "Glazing Manual." For glass in wood frames, secure glass with removable stops.

PART 3 - EXECUTION

3.1 PREPARATION

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

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

3.2 INSTALLATION

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

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

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

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

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

1. Use filler matching finish of items being installed.

F. Cabinets: Install without distortion so doors and drawers fit openings properly and are accurately aligned. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation. Complete installation of hardware and accessory items as indicated.

1. Install cabinets with no more than 1/8 inch in 96-inch sag, bow, or other variation from a straight line.
2. Fasten wall cabinets through back, near top and bottom, and at ends not more than 16 inches o.c. with toggle bolts through metal backing or metal framing behind wall finish.

3.3 ADJUSTING AND CLEANING

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

B. Clean, lubricate, and adjust hardware.

C. Clean cabinets on exposed and semiexposed surfaces.

END OF SECTION

SECTION 066400 - PLASTIC PANELING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes glass-fiber reinforced plastic (FRP) wall paneling.

B. Related Sections:

1. Section 102600 "Wall Protection" for corner guards installed over plastic paneling.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples: For plastic paneling and trim accessories.

1.3 QUALITY ASSURANCE

A. Testing Agency: Acceptable to authorities having jurisdiction.

PART 2 - PRODUCTS

2.1 PLASTIC SHEET PANELING

A. Glass-Fiber-Reinforced Plastic Paneling: Gelcoat-finished, glass-fiber-reinforced plastic panels complying with ASTM D 5319.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Standard FRP by Marlite, www.marlite.com, or comparable product by one of the following:
   a. Crane Composites, Inc.; www.cranecomposites.com
   b. Fibertech; www.fibertech.net
   c. Fiberglass Specialties, Inc.; www.fiberglassspecialties.com
   d. Kwalu LLC; www.kwalu.com

2. Surface-Burning Characteristics: As follows when tested by a qualified testing agency according to ASTM E 84. Identify products with appropriate markings of applicable testing agency.
   a. Flame-Spread Index: 200 or less.
   b. Smoke-Developed Index: 450 or less.

3. Nominal Thickness: Not less than 0.09 inch.
4. Surface Finish: As selected by Architect from manufacturer's full range.
5. Color: As selected by Architect from manufacturer's full range.

2.2 ACCESSORIES

A. Trim Accessories: Manufacturer's standard one-piece vinyl extrusions designed to retain and cover edges of panels. Provide division bars, inside corners, outside corners, and caps as needed to conceal edges.

1. Color: Match panels.

B. Adhesive: As recommended by plastic paneling manufacturer.

1. Adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

C. Sealant: Mildew-resistant, single-component, neutral-curing silicone sealant recommended by plastic paneling manufacturer and complying with requirements in Section 079200 "Joint Sealants."

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean substrates of substances that could impair adhesive bond, including oil, grease, dirt, and dust.

B. Condition panels by unpacking and placing in installation space before installation according to manufacturer's written recommendations.

C. Lay out paneling before installing. Locate panel joints to provide equal panels at ends of walls not less than half the width of full panels.

3.2 INSTALLATION

A. Install plastic paneling according to manufacturer's written instructions.

B. Install panels in a full spread of adhesive.

C. Install trim accessories with adhesive and nails or staples. Do not fasten through panels.

D. Fill grooves in trim accessories with sealant before installing panels, and bed inside corner trim in a bead of sealant.

E. Maintain uniform space between panels and wall fixtures. Fill space with sealant.

F. Remove excess sealant and smears as paneling is installed. Clean with solvent recommended by sealant manufacturer and then wipe with clean dry cloths until no residue remains.

END OF SECTION 066400

SECTION 072100 - THERMAL INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Cavity-wall insulation.
2. Glass fiber blanket insulation.

B. Related Requirements:

1. Section 075200 “Modified Bitumen Membrane Roofing” for polyisocyanurate roof insulation.

1.2 DEFINITIONS

A. Mineral-Fiber Insulation: Insulation composed of rock-wool fibers, slag-wool fibers, or glass fibers; produced in boards and blanket with latter formed into batts (flat-cut lengths) or rolls.

1.3 PERFORMANCE REQUIREMENTS

A. Plenum Rating: Provide glass-fiber insulation where indicated in ceiling plenums whose test performance is rated as follows for use in plenums as determined by testing identical products per "Erosion Test" and "Mold Growth and Humidity Test" described in UL 181, or on comparable tests from another standard acceptable to authorities having jurisdiction.

1. Erosion Test Results: Insulation shows no visible evidence of cracking, flaking, peeling, or delamination of interior surface of duct assembly, after testing for 4 hours at 2500-fpm air velocity.
2. Mold Growth and Humidity Test Results: Insulation shows no evidence of mold growth, delamination, or other deterioration due to the effects of high humidity, after inoculation with Chaetomium globosium on all surfaces and storing for 60 days at 100 percent relative humidity in the dark.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency for insulation products.

1.5 QUALITY ASSURANCE

A. Source Limitations: Obtain each type of building insulation through one source from a single manufacturer.

B. Fire-Test-Response Characteristics: Provide insulation and related materials with the fire-test-response characteristics indicated, as determined by testing identical products per test method indicated below by UL or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify materials with appropriate markings of applicable testing and inspecting agency.

1. Surface-Burning Characteristics: ASTM E 84.
2. Fire-Resistance Ratings: ASTM E 119.
3. Combustion Characteristics: ASTM E 136.

1.6 DELIVERY, STORAGE, AND HANDLING

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

PART 2 - PRODUCTS

2.1 THERMAL INSULATION

A. Cavity Wall Insulation:

1. Extruded Polystyrene Board, Type IV: ASTM C 578, Type IV, 25-psi minimum compressive strength; unfaced; maximum flame-spread and smoke-developed indexes of 25 and 450, respectively, per ASTM E 84.
   a. Product: Owens Corning, Foamular 250 or Dow Styrofoam, CavityMate Plus.
   b. Thickness: 1 inch, R-5.
   c. Fire Propagation Characteristics: Passes NFPA 285 testing as part of an approved assembly.

B. Glass Fiber Blanket Insulaton:

1. Glass-Fiber Blanket, Unfaced: ASTM C 665, Type I; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively, per ASTM E 84; passing ASTM E 136 for combustion characteristics.
   a. Product: Owens Corning EcoTouch Insulation or Johns-Manville Formaldehyde-Free Fiber Glass Insulation.
   b. Thickness: 6 inch, R-19.

2.2 ACCESSORIES

A. Insulation for Miscellaneous Voids:

1. Glass-Fiber Insulation: ASTM C 764, Type II, loose fill; with maximum flame-spread and smoke-developed indexes of 5, per ASTM E 84.
2. Spray Polyurethane Foam Insulation: ASTM C 1029, Type II, closed cell, with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, per ASTM E 84.

B. Adhesive for Bonding Insulation: Product compatible with insulation and air barrier materials, and with demonstrated capability to bond insulation securely to substrates without damaging insulation and substrates.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements of Sections in which substrates and related work are specified and for other conditions affecting performance.

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

3.2 PREPARATION

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

3.3 INSTALLATION, GENERAL

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

B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed at any time to ice, rain, and snow.

C. Extend insulation in thickness indicated to envelop entire area to be insulated. Cut and fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.

D. Water-Piping Coordination: If water piping is located within insulated exterior walls, coordinate location of piping to ensure that it is placed on warm side of insulation and insulation encapsulates piping.

E. For preformed insulating units, provide sizes to fit applications indicated and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units to produce thickness indicated unless multiple layers are otherwise shown or required to make up total thickness.

3.4 INSTALLATION OF CAVITY-WALL, INSULATION

A. On units of rigid board insulation, install pads of adhesive spaced approximately 24 inches o.c. both ways on inside face, and as recommended by manufacturer. Fit courses of insulation between wall ties and other obstructions, with edges butted tightly in both directions. Press units firmly against inside substrates indicated.

3.5 INSTALLATION OF INSULATION IN FRAMED CONSTRUCTION

A. Apply insulation units to substrates by method indicated, complying with manufacturer's written instructions. If no specific method is indicated, bond units to substrate with adhesive or use mechanical anchorage to provide permanent placement and support of units.

B. Install blanket insulation in cavities formed by framing members according to the following requirements:

1. Use insulation widths and lengths that fill the cavities formed by framing members. If more than one length is required to fill cavity, provide lengths that will produce a snug fit between ends.
2. Place insulation in cavities formed by framing members to produce a friction fit between edges of insulation and adjoining framing members.
3. Maintain 3-inch clearance of insulation around recessed lighting fixtures.
4. Install eave ventilation troughs between roof framing members in insulated attic spaces at vented eaves.
5. For metal-framed wall cavities where cavity heights exceed 96 inches, support unfaced blankets mechanically and support faced blankets by taping flanges of insulation to flanges of metal studs.

C. Miscellaneous Voids: Install insulation in miscellaneous voids and cavity spaces where required to prevent gaps in insulation using the following materials:

1. Glass-Fiber Insulation: Compact to approximately 40 percent of normal maximum volume equaling a density of approximately 2.5 lb/cu. ft.
2. Spray Polyurethane Insulation: Apply according to manufacturer's written instructions.

3.6 PROTECTION

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

END OF SECTION

SECTION 072216 – ROOF BOARD INSULATION (GARLAND)

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Base layer insulation, tapered cricket insulation and secondary/cover board insulation.

B. Related Sections include the following:

1. Division 07 Section “SBS Modified Bituminous Membrane Roofing.”
2. Division 07 Section “Sheet Metal Flashing and Trim.”

1.2 REFERENCES

A. American Society for Testing and Materials (ASTM):

B. Standards:

1. FM Global Approval Guide.
2. Underwriters Laboratories: Building Materials Guide.
3. National Roofing Contractors Association (NRCA): The NRCA Roofing and Waterproofing Manual.

C. ASCE 7-10: “Minimum Design Loads for Buildings and Other Structures”.

D. Polyisocyanurate Insulation Manufacturer’s Association: Technical Bulletin 109 – “Storage and Handling Recommendations for Polyisocyanurate”.

1.3 SUBMITTALS

A. Product Data: Submit manufacturer’s product data sheets, providing descriptive data, dimensions, LTTR values, and other pertinent criteria for each material proposed for use in construction of roof assembly.

B. Samples: Provide physical examples of materials/components proposed for use to compromise the specified roof system.

1.4 QUALITY ASSURANCE

A. Regulatory Requirements:

1. Classified by Underwriters Laboratories Inc as Class A rated material.
2. Follow local, state and federal regulations, safety standards and codes. When conflict exists, the more restrictive document shall govern.

B. Installation:

1. Install in accordance with manufacturer’s current published application procedures, general requirements of NRCA, and as supplemented by these documents.
2. Consider roof system manufacturer’s technical specifications part of this Specification and use as reference for specific application procedures.

3. Install roof system in accordance with prime roof material manufacturer's technical departments uplift calculations and attachment requirements. Negative pressures shall be based on ASCE 7-10.

1.5 DELIVERY, STORAGE AND HANDLING

A. Store materials in accordance with manufacturer's recommendations.

B. Outdoor Storage:

1. Tarp and shield insulation from moisture and exposure to sun.
2. Elevate insulation above substrate 4-inches minimum.
3. Secure insulation to resist winds.
4. Do not use insulation which has been determined "wet" or which has been been wet and has dried.
5. Distribute insulation stored on roof deck to prevent concentrated loads that would impose excessive stress or strain on deck and structural members or impede drainage.

1.6 SEQUENCING AND SCHEDULING

A. Plan roof layout with respect to roof deck slope to prevent rainwater drainage into completed roofing.

B. Do not install more insulation than can be made watertight in same day.

1.7 PROJECT CONDITIONS

A. Environmental recommendations:

1. Apply roofing and insulation in dry weather.
2. Do not proceed with roof construction during inclement weather or when precipitation is predicted with 30 percent or higher probability.
3. Do not apply insulation over wet or moist deck or in foggy conditions.
4. Wind speeds in excess of 30 mph shall constitute "Inclement Weather".

B. Maintain on-site equipment and material necessary to apply emergency temporary weather protection to incomplete work in event of sudden or unexpected precipitation.

PART 2 - PRODUCTS

2.1 ROOF INSULATION

A. Base Layer Insulation: Rigid, closed cell polyisocyanurate rigid board insulation utilizing non-chlorine/non-ozone depleting blowing agent, bonded to non-asphaltic coated fiberglass facers, ASTM C 1289, Type II, Class 1, Grade 2 (20 psi), 4.4-inch total thickness (R-25); maximum board size 48" x 96" for mechanically attached applications: "VPG-CG" by Viking Products Group or pre-approved equal.

1. Base insulation layer shall consist of one (2) 2.2-inch boards, all joints staggered.

B. Tapered Insulation: Rigid, closed cell polyisocyanurate rigid board insulation utilizing non-chlorine/non-ozone depleting blowing agent, bonded to non-asphaltic coated fiberglass facers, ASTM C 1289, Type II, Class 1, Grade 2 (20 psi), tapered 1/4" per foot minimum: "Tapered VPG-CG" by Viking Products Group or pre-approved equal.

C. Secondary Insulation Layer/Cover Board: Moisture resistant, 1/2-inch thick gypsum roof board, ASTM C 1278; provide 48” by 48” nominal size: “DensDeck Prime” by Georgia Pacific or pre-approved equal.

D. Tapered Edge Strip: Tapered perlite complying with ASTM C 728.

2.2 RELATED MATERIALS

A. Compressible Fill Insulation: Foil or paper-faced compressible fiberglass batten roll insulation of proper size and thickness to insert at openings at penetrations, perimeters, and curbs: Manufactured by Owens Corning or pre-approved equal.

B. Cant Strips: Inorganic fibrous glass, dimensionally stable and fire resistant with 3-5/8” face. “Glass Cant” by The Garland Co., Inc. or pre-approved equal.

C. Low-Rise Foam Insulation Adhesive: Dual-component, VOC compliant, two-part reaction-cure urethane foam adhesive. “Insul-Lock HR” by The Garland Co., Inc. or pre-approved equal.

D. Steel Deck Insulation Fasteners: CR-10 flourocarbon coated, self-tapping screws of sufficient length to penetrate the steel deck a minimum of 1-inch, with 3-inch steel plates with recessed screw head for use with roof board insulation: “#12 Standard Roof Fastener” manufactured by OMG or ES Products.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Roof system manufacturer’s representative shall inspect roof deck and associated substrates and provide written acceptance of conditions.

B. Manufacturer’s approved roofing contractor shall inspect and approve deck and substrates.

C. Roofing contractor shall examine roof deck and related substrates and verify that there are no conditions that would prevent roof system manufacturer’s approved application of roof system. These conditions include, but are not limited to, the following:

1. Inadequate support or anchorage of decking or substrates to structure.
2. Accumulations of moisture.
3. Tears, holes, or punctures.
4. Ridges, uneven conditions, or gaps.
5. Rust or other forms of deterioration.
6. Presence of foreign materials.

D. Start of work constitutes acceptance of substrate and site conditions.

3.2 PROTECTION

A. Provide special protection from traffic on yet to be removed roofing and newly installed roof materials.

3.3 APPLICATION

A. General:

1. Install insulation to achieve a minimum R-30 continuous across the roof deck in general accordance with manufacturer's guidelines.
2. Stagger end joints of insulation boards ½ of overall length of board.
3. Butt joints tightly allowing no more than ¼-inch wide gaps between units. Fill joints between adjacent boards with like insulation or foam adhesive.
4. Do not use warped, bent or otherwise damaged insulation boards.
5. Field cut and fit insulation at penetrations, curbs, and walls.
6. Stagger all joints (side and end) between layers of insulation.
7. Field cut tapered insulation boards to create crickets at upslope sides of curbs and along walls to achieve a minimum resulting roof slope of ¼" per foot.
8. Install tapered edge strips at changes in elevations, edge of crickets and other locations to create a monolithic and uniform substrate for installation of roofing membrane.

B. Mechanically Attached Insulation Layer:

1. Mechanically attach polyisocyanurate insulation layer to deck.
2. Install insulation with longitudinal joints continuous and end joints staggered.
3. Mechanically attach insulation to roof deck in strict accordance with roof membrane manufacturer's project specific ASCE 7-10 calculations.
4. Fully engage and seat fasteners. Do not over tighten or strip threads. Bent, deformed, or unseated fasteners or plates are unacceptable.
5. Fasteners must penetrate deck 1-inch, minimum, through the deck. Do not overdrive fasteners. Remove and replace overdriven, stripped, or non-engaged fasteners.
6. Properly seat mechanical fasteners and keep heads flush with plates. Cupped plates or unseated screw heads are not acceptable.
7. Do not rupture or deform surface of the insulation by mechanical fastening.

C. Adhered Layers of Insulation:

1. Adhere tapered insulation layer and cover board to base insulation layer.
2. Stagger end joints of insulation boards ½ of overall length of board. Stagger joints of subsequent insulation layers from underlying insulation layer.
3. Butt joints of insulation layers tightly allowing no more than ¼-inch wide gaps between units. Fill joints or gaps greater than 1/8-inch between adjacent boards with low-rise foam adhesive.
4. Do not use warped, bent, or otherwise damaged insulation boards. Discard damaged boards.
5. Field cut and fit insulation boards at penetrations, curbs, and walls. Field cut tapered insulation boards to create crickets at upslope sides of curbs and along walls.
6. Install cover board over insulation in accordance with manufacturer's guidelines.

D. Ribbon Application (Urethane Foam Insulation Adhesive):

1. Dispense 1/2-inch wide continuous ribbons of adhesive on substrate to adhere insulation board.
2. Place the initial ribbon of adhesive 3-inches inside each edge/side of the insulation board in a picture-frame fashion. Apply additional parallel ribbons of adhesive across the remainder of the board in a serpentine fashion and spaced according to roof membrane manufacturer's ASCE 7-10 calculations.

3. Firmly set insulation boards in the ribbons of foam adhesive following application of the adhesive when adhesive has risen to proper height and walk-in the insulation to spread the adhesive ribbons, ensuring maximum contact. Do not push or slide insulation into position. Set weighted objects on ends, sides, and corners of boards until adhesive has set and insulation is firmly attached.
4. On additional insulation layers, dispense ribbons of adhesive in direction perpendicular to the direction of the beads that were dispensed on the underlying layer.
5. Fill voids or open joints in top layer of insulation with spray-foam adhesive to provide monolithic surface to receive new membrane.
6. Adhere partial boards and tapered edge strips with adhesive ribbon positioned in picture-frame fashion along perimeter of board and remaining adhesive ribbons spaced in accordance with location on roof (field, perimeter, corner).
7. At end of each work day, provide staggered ends of installed boards so that proper joint stagger can be achieved on following roof installation.

E. Insulation Filler: Install compressible fiberglass insulation at openings in deck at penetrations, perimeters, expansion joints, and/or curbs.

3.4 CLEANING

A. Remove debris and material wrappers from roof to dumpster daily. Leave insulation clean, dry, and ready to receive new roofing.

3.5 ADJUSTING

A. Remove damaged insulation and install acceptable new units before installation of roof membrane system.

END OF SECTION 072216

SECTION 072726 - AIR BARRIERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:

1. Fluid-applied, vapor-permeable membrane air barriers.

B. Related Requirements:

1. Section 042100 “Architectural Unit Masonry” for masonry tie-in to adjacent construction systems.
2. Section 061600 "Sheathing" for wall sheathing materials receiving air barrier and joint treatment.
3. Section 072100 “Thermal Insulation” for installation of cavity wall insulation over air barrier membrane.
4. Section 075200 “Modified Bitumen Membrane Roofing” for air barrier interface with roof membrane.
5. Section 076200 “Sheet Metal Flashing and Trim for sheet metal flashings required for complete watertight envelope assembly.
6. Section 079200 “Joint Sealants” for joint-sealant materials and installation.

1.2 DEFINITIONS

A. Air-Barrier Material: A primary element that provides a continuous barrier to the movement of air.

B. Air-Barrier Accessory: A transitional component of the air barrier that provides continuity.

C. Air-Barrier Assembly: The collection of air-barrier materials and accessory materials applied to an opaque wall, including joints and junctions to abutting construction, to control air movement through the wall.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review air-barrier requirements and installation, special details, mockups, air-leakage and bond testing, air-barrier protection, and work scheduling that covers air barriers.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include manufacturer's written instructions for evaluating, preparing, and treating substrate; technical data; and tested physical and performance properties of products.
2. Identify all materials and accessories required for complete watertight installation to be approved by weather barrier manufacturer as complete system and warranted as such.

B. Shop Drawings: For air-barrier assemblies.

1. Show locations and extent of air barrier. Include details for substrate joints and cracks, counterflashing strips, penetrations, inside and outside corners, terminations, and tie-ins with adjoining construction.
2. Include details of interfaces with other materials that adjoin the air barrier.

C. Manufacturer's Certification: Provide letter indicating that selected air barrier products are compatible with the selected wall sheathing, and that coverage rates and substrate preparation steps have been adjusted, if necessary, to reflect the particular absorption rate of the selected sheathing.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer

B. Product Certificates: From air-barrier manufacturer, certifying compatibility of air barriers and accessory materials with Project materials that connect to or that come in contact with the barrier.

C. Product Test Reports: For each air-barrier assembly, for tests performed by a qualified testing agency.

D. Manufacturer's Warranty: Provide a copy of air barrier manufacturer's 10 year standard warranty.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer with a minimum of 10 successful years documented experience with similar products, and capable of meeting requirements for single-source responsibility.

B. Mockups: Apply air barrier to comprehensive mockups specified in Section 042100 "Architectural Unit Masonry" and Section 074264 "Metal Composite Material Wall Panels."•

C. Mockups: In addition, build mockups to set quality standards for materials and execution and for preconstruction testing.

1. Build comprehensive mockup of exterior wall assembly, incorporating backup wall construction, window framing, ties and other penetrations, and typical flashing to demonstrate surface preparation, crack and joint treatment, application of air barriers, and sealing of gaps, terminations, and penetrations of air-barrier assembly.
   a. Coordinate construction of mockups to permit inspection by Owner's testing agency of air barrier before external insulation and cladding are installed.
   b. Include junction with roofing underlayment, building corner condition, and foundation wall intersection.
   c. If Architect determines mockups do not comply with requirements, reconstruct mockups and apply air barrier until mockups are approved.
2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.

1.7 PRECONSTRUCTION TESTING

A. Preconstruction Testing Service: Owner will engage a qualified testing agency to perform preconstruction testing on field mockups.

B. Mockup Testing: Air-barrier assemblies shall comply with performance requirements indicated, as evidenced by reports based on mockup testing by a qualified testing agency.

1. Adhesion Testing: Mockups will be tested for minimum air-barrier adhesion of 30 lbf/sq. in. according to ASTM D 4541.
2. Membrane Thickness Testing: Mockups will be tested for minimum wet and dry mil thicknesses to verify the installation meets manufacturer's requirements.
3. Notify Architect seven days in advance of the dates and times when mockups will be tested.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Remove and replace liquid materials that cannot be applied within their stated shelf life.

B. Protect stored materials from direct sunlight.

1.9 FIELD CONDITIONS

A. Environmental Limitations: Apply air barrier within the range of ambient and substrate temperatures recommended by air-barrier manufacturer.

1. Protect substrates from environmental conditions that affect air-barrier performance.
2. Do not apply air barrier to a damp or wet substrate or during snow, rain, fog, or mist.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

A. Source Limitations: Obtain primary air-barrier materials and air-barrier accessories from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. General: Air barrier shall be capable of performing as a continuous vapor- permeable air barrier and as a liquid-water drainage plane flashed to discharge to the exterior incidental condensation or water penetration. Air-barrier assemblies shall be capable of accommodating substrate movement and of sealing substrate expansion and control joints, construction material changes, penetrations, tie-ins to installed waterproofing, and transitions at perimeter conditions without deterioration and air leakage exceeding specified limits.

B. Air-Barrier Assembly Air Leakage: Maximum 0.04 cfm/sq. ft. of surface area at 1.57 lbf/sq. ft., when tested according to ASTM E 283, ASTM E 783 or ASTM E 2357.

C. Fire Propagation Characteristics: Test air barrier products together with all combustible components of each exterior wall assembly for compliance with NFPA 285 requirements.

2.3 VAPOR-PERMEABLE MEMBRANE AIR-BARRIER

A. Products: Subject to compliance with requirements, provide one of the following:

B. Fluid-Applied, Vapor-Permeable Membrane Air Barrier: Elastomeric, synthetic polymer or acrylic membrane.

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. Synthetic Polymer Membrane:
      1) Carlisle Coatings & Waterproofing Inc.; Fire Resist Barritech VP.
      2) GCP Applied Technologies; Perm-A-Barrier VPL.
      3) Henry Company; Air-Bloc 31 or 33.

2. Physical and Performance Properties:
   a. Air Permeance: Maximum 0.004 cfm/sq. ft. of surface area at 1.57-lbf/sq. ft. pressure difference; ASTM E 2178.
   b. Vapor Permeance: Minimum 10 perms to 25 perms maximum; ASTM E 96/E 96M.
   c. Ultimate Elongation: Minimum 200 percent; ASTM D 412, Die C.
   d. Ultraviolet and Weathering Resistance: Approved in writing by manufacturer for minimum of 9 months weather exposure.
   e. Adhesion to Glass Mat Faced Sheathing: Sufficient to ensure failure due to delamination of sheathing.

2.4 ACCESSORY MATERIALS

A. General: Accessory materials recommended by air-barrier manufacturer to produce a complete air-barrier assembly and compatible with primary air-barrier material.

B. Primer: Liquid waterborne primer recommended for substrate by air-barrier material manufacturer.

C. Counterflashing Strip: Modified bituminous, 40-mil- thick, self-adhering sheet consisting of 32 mils of rubberized asphalt laminated to an 8-mil- thick, cross-laminated polyethylene film with release liner backing.

D. Butyl Strip: Vapor retarding, 30 to 40 mils thick, self-adhering; polyethylene-film-reinforced top surface laminated to layer of butyl adhesive with release liner backing.

E. Modified Bituminous Transition Strip: Vapor retarding, 40 mils thick, smooth surfaced, self-adhering; consisting of 36 mils of rubberized asphalt laminated to a 4-mil- thick polyethylene film with release liner backing.

F. High-Temperature Modified Bituminous Transition Strip: Modified bituminous strip designed for exposure to temperatures up to 240 degrees F. without melting or dripping. Use behind metal flashing or metal wall or roof panels.

G. Joint Reinforcing Strip: Air-barrier manufacturer's glass-fiber-mesh tape.

H. Substrate-Patching Membrane: Manufacturer's standard trowel-grade substrate filler.

I. Adhesive and Tape: Air-barrier manufacturer's standard adhesive and pressure-sensitive adhesive tape.

J. Stainless-Steel Sheet: ASTM A 240/A 240M, Type 304, 0.0250 inch thick, and Series 300 stainless-steel fasteners.

K. Joint Sealant: ASTM C 920, single-component, neutral-curing silicone; Class 100/50 (low modulus), Grade NS, Use NT related to exposure, and, as applicable to joint substrates indicated, Use O. Comply with Section 079200 "Joint Sealants."

L. Termination Mastic: Air-barrier manufacturer's standard cold fluid-applied elastomeric liquid; trowel grade.

PART 3 - EXECUTION

3.1 EXAMINATION

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

1. Verify that substrates are sound and free of oil, grease, dirt, excess mortar, or other contaminants.
2. Verify that concrete has cured and aged for minimum time period recommended by air-barrier manufacturer.
3. Verify that concrete is visibly dry and free of moisture. Test for capillary moisture by plastic sheet method according to ASTM D 4263.
4. Verify that masonry joints are flush and completely filled with mortar.

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

3.2 SURFACE PREPARATION

A. Clean, prepare, treat, and seal substrate according to manufacturer's written instructions. Provide clean, dust-free, and dry substrate for air-barrier application.

B. Mask off adjoining surfaces not covered by air barrier to prevent spillage and overspray affecting other construction.

C. Remove grease, oil, bitumen, form-release agents, paints, curing compounds, and other penetrating contaminants or film-forming coatings from concrete.

D. Remove fins, ridges, mortar, and other projections and fill honeycomb, aggregate pockets, holes, and other voids in concrete with substrate-patching membrane.

E. Remove excess mortar from masonry ties, shelf angles, and other obstructions.

F. At changes in substrate plane, apply sealant or termination mastic beads at sharp corners and edges to form a smooth transition from one plane to another.

G. Cover gaps in substrate plane and form a smooth transition from one substrate plane to another with stainless-steel sheet mechanically fastened to structural framing to provide continuous support for air barrier.

H. Cover exposed core of sheathing with liquid membrane or manufacturer’s recommended sealant. Fill fastener head divots and holes in sheathing with the air barrier manufacturer’s recommended liquid membrane sealant or air barrier material prior to application of air barrier.

3.3 JOINT TREATMENT

A. Concrete and Masonry: Prepare, treat, rout, and fill joints and cracks in substrate according to ASTM C 1193 and air-barrier manufacturer's written instructions. Remove dust and dirt from joints and cracks complying with ASTM D 4258 before coating surfaces.

1. Prime substrate and apply a single thickness of air-barrier manufacturer's recommended preparation coat extending a minimum of 3 inches along each side of joints and cracks. Apply a double thickness of fluid air-barrier material and embed a joint reinforcing strip in preparation coat.

B. Exterior Sheathing: Fill joints greater than 1/4 inch with sealant according to ASTM C 1193 and apply silicone sealant between joints. Apply sealant and tape joints according to air-barrier manufacturer's written instructions and Section 061600. Apply first layer of fluid air-barrier material at joints. Tape joints with joint reinforcing strip after first layer is dry. Apply a second layer of fluid air-barrier material over joint reinforcing strip.

3.4 TRANSITION STRIP INSTALLATION

A. General: Install strips, transition strips, and accessory materials according to air-barrier manufacturer's written instructions to form a seal with adjacent construction and maintain a continuous air barrier.

1. Coordinate the installation of air barrier with installation of roofing membrane and base flashing to ensure continuity of air barrier with roofing membrane.
2. Install compatible modified bituminous strip on roofing membrane or base flashing so that a minimum of 3 inches of coverage is achieved over each substrate. Shingle-lap air barrier components to the greatest extent possible.

B. Apply primer to substrates at required rate and allow it to dry. Limit priming to areas that will be covered by fluid air-barrier material on same day. Reprime areas exposed for more than 24 hours.

1. Prime glass-fiber-surfaced gypsum sheathing with number of prime coats needed to achieve required bond, with adequate drying time between coats.

C. Connect and seal exterior wall air-barrier material continuously to roofing-membrane air barrier, concrete below-grade structures, floor-to-floor construction, exterior glazing and window systems, glazed curtain-wall systems, storefront systems, exterior louvers, exterior door framing, and other construction used in exterior wall openings, using accessory materials.

D. At end of each working day, seal top edge of strips and transition strips to substrate with termination mastic.

E. Apply joint sealants forming part of air-barrier assembly within manufacturer's recommended application temperature ranges. Consult manufacturer when sealant cannot be applied within these temperature ranges.

F. Seal joints between frames of windows, curtain walls, storefronts, doors, and other items penetrating the air-barrier membrane with elastomeric sealant in accordance with the air barrier manufacturer’s requirements and Section 079200 “Joint Sealants.” Apply sealant in two layers, forming primary and secondary seals.

G. Seal strips and transition strips around masonry reinforcing or ties and penetrations with termination mastic.

H. Seal top of through-wall flashings to air barrier with an additional 6-inch- wide, modified bituminous strip.

I. Seal exposed edges of strips at seams, cuts, penetrations, and terminations not concealed by metal counterflashings or ending in reglets with termination mastic.

J. Repair punctures, voids, and deficient lapped seams in strips and transition strips. Slit and flatten fishmouths and blisters. Patch with transition strips extending 6 inches beyond repaired areas in strip direction.

3.5 FLUID AIR-BARRIER MEMBRANE INSTALLATION

A. General: Apply fluid air-barrier material to form a seal with strips and transition strips and to achieve a continuous air barrier according to air-barrier manufacturer's written instructions. Apply fluid air-barrier material within manufacturer's recommended application temperature ranges.

1. Apply primer to substrates at required rate and allow it to dry.
2. Limit priming to areas that will be covered by fluid air-barrier material on same day. Reprime areas exposed for more than 24 hours.
3. Prime glass-fiber-surfaced gypsum sheathing with number of prime coats needed to achieve required bond, with adequate drying time between coats.

B. Membrane Air Barriers: Apply a continuous unbroken air-barrier membrane to substrates according to the following thickness. Apply air-barrier membrane in full contact around protrusions such as masonry ties.

1. Vapor-Permeable Membrane Air Barrier: Total dry film thickness as recommended in writing by manufacturer to meet performance requirements, but not less than 40-mil dry film thickness, applied in two equal coats.

C. Apply strip and transition strip a minimum of 1 inch onto cured air-barrier material or strip and transition strip over cured air-barrier material overlapping 3 inches onto each surface according to air-barrier manufacturer's written instructions.

D. Do not cover air barrier until it has been tested and inspected by Owner's testing agency.

E. Correct deficiencies in or remove air barrier that does not comply with requirements; repair substrates and reapply air-barrier components.

F. Apply air barrier to substrate in manufacturer’s instructed wet and dry mil thicknesses.

G. Quality Control: As work progresses, take regular wet mil thickness measurements of applied air barrier membrane. Record results and submit log to Architect for review.

3.6 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. Inspections: Air-barrier materials, accessories, and installation are subject to inspection for compliance with requirements. Inspections may include the following:

1. Continuity of air-barrier system has been achieved throughout the building envelope with no gaps or holes.

2. Continuous structural support of air-barrier system has been provided.
3. Masonry and concrete surfaces are smooth, clean, and free of cavities, protrusions, and mortar droppings.
4. Site conditions for application temperature and dryness of substrates have been maintained.
5. Maximum exposure time of materials to UV deterioration has not been exceeded.
6. Surfaces have been primed, if applicable.
7. Laps in strips and transition strips have complied with minimum requirements and have been shingled in the correct direction (or mastic has been applied on exposed edges), with no fishmouths.
8. Termination mastic has been applied on cut edges.
9. Strips and transition strips have been firmly adhered to substrate.
10. Compatible materials have been used.
11. Transitions at changes in direction and structural support at gaps have been provided.
12. Connections between assemblies (air-barrier and sealants) have complied with requirements for cleanliness, surface preparation and priming, structural support, integrity, and continuity of seal.
13. All penetrations have been sealed.

C. Tests: As determined by Owner's testing agency from among the following tests:

1. Adhesion Testing: Air-barrier assemblies will be tested for minimum air-barrier adhesion of 30 lbf/sq. in. according to ASTM D 4541 for each 600 sq. ft. of installed air barrier or part thereof.
2. Membrane Thickness Testing: Provide wet and dry mil testing to verify the installation meets manufacturer’s requirements.

D. Air barriers will be considered defective if they do not pass tests and inspections.

1. Apply additional air-barrier material, according to manufacturer's written instructions, where inspection results indicate insufficient thickness.
2. Remove and replace deficient air-barrier components for retesting as specified above.

E. Repair damage to air barriers caused by testing; follow manufacturer's written instructions.

3.7 CLEANING AND PROTECTION

A. Protect air-barrier system from damage during application and remainder of construction period, according to manufacturer's written instructions.

1. Protect air barrier from overexposure to UV light and harmful weather conditions as instructed by manufacturer. Do not exceed manufacturer’s time limits for exposure. If exposure limits are exceeded, repair or replace overexposed membrane as directed by manufacturer.
2. Protect air barrier from contact with incompatible materials and sealants not approved by air-barrier manufacturer.

B. Clean spills, stains, and soiling from construction that would be exposed in the completed work using cleaning agents and procedures recommended by manufacturer of affected construction.

C. Remove masking materials after installation.

END OF SECTION

SECTION 074200 - EXTERIOR WALL AND SOFFIT CLADDING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Composite wood wall and soffit cladding.
2. Steel attachment system.

B. Related Sections:

1. Section 054000 "Cold-Formed Metal Framing" for support framing, including purlins, girts, studs, and bracing.
2. Section 061600 “Sheathing for exterior sheathing behind cladding.
3. Section 072100 “Thermal Insulation for continuous wall insulation behind cladding.
4. Section 072726 "Air Barriers" for continuous air barrier systems.
5. Section 076200 "Sheet Metal Flashing and Trim" for flashing and sheet metal work.

1.2 PERFORMANCE REQUIREMENTS

A. General Performance: Cladding panel assemblies shall comply with performance requirements without failure due to defective manufacture, fabrication, installation, or other defects in construction.

B. Contractor design Work(Delegated Design): Design cladding panel assemblies, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

C. Structural Performance:

1. Wind Loads: Provide cladding panel assemblies, including anchorage, capable of withstanding wind-load design pressures calculated according to requirements of authorities having jurisdiction or the American Society of Civil Engineers ASCE 7 "Minimum Design Loads for Buildings and Other Structures" 6.4.2, "Analytical Procedure", whichever is more stringent, using the factors indicated on the Drawings.
2. Deflection Limits: Cladding panel assemblies shall withstand wind loads with horizontal deflections no greater than 1/200 of the span.

D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes by preventing buckling, overstressing of components, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

1.3 PREINSTALLATION MEETINGS

A. Pre-installation Conference: Conduct conference at Project site.

B. Meet with Owner, Architect, installer, manufacturer's representative, structural-support Installer, and installers whose work interfaces with or affects exterior wall cladding, including installers of doors, windows, and louvers.

C. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.

D. Review methods and procedures related to cladding installation, including manufacturer's written instructions.

E. Examine support conditions for compliance with requirements, including alignment between and attachment to structural members.

F. Review flashings, special siding details, wall penetrations, openings, and condition of other construction that affect cladding.

G. Review governing regulations and requirements for insurance, certificates, and tests and inspections if applicable.

H. Review temporary protection requirements for Cladding Panel assembly during and after installation.

I. Review procedures for repair of panels damaged after installation.

J. Document proceedings, including corrective measures and actions required, and furnish copy of record to each participant.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of panel and accessory.
2. Storage and handling requirements and recommendations.

B. Shop Drawings: Sealed by the Professional Engineer responsible for their creation and registered in the State of Texas.

1. Include fabrication and installation layouts, details of edge conditions, joints, cladding profiles, corners, anchorages, attachment assembly, trim, flashings, closures, accessories, and special details. Include rain screen attachment system.
2. Provide construction details for penetrations, joints and sealing requirements of air barrier at building envelope.
3. Accessories: Include details of the flashing, trim and anchorage, at a scale of not less than 1-1/2 inches per 12 inches.

C. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below.

1. inches long by 12 inches in width. Include fasteners, trim, closures, and other cladding accessories.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Engineering Calculations: For panel attachment system, sealed by a Professional Engineer licensed in the State of Texas.

C. Product Test Reports: For each product, tests performed by a qualified testing agency.

D. Field quality-control reports.

E. Sample Warranties: For special warranties.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

B. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.

1. Build integrated mockup of cladding assemblies, 8 x 8 feet in size, showing wall cladding, backup wall, sheathing, air barrier, flashing, clips, and related accessories necessary to illustrate complete wall construction methods.
2. Include storefront framing and transition flashing.
3. Approval of mockup does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Delivery: Deliver Materials to site in Manufacturer's original, unopened packaging, with labels clearly identifying product name and manufacturer.

1.8 FIELD CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit assembly of rainscreen system to be performed according to manufacturers' written instructions and warranty requirements.

1.9 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of exterior wall and soffit cladding that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to: cracking, splitting, rotting, flaking, splintering, peeling, and damage from moisture or termites.
2. Warranty Period: Ten years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 WOOD WALLS AND SOFFITS

A. General: Wall and soffit cladding consisting of prefinished wood planks mounted to a concealed aluminum attachment system with concealed and exposed fasteners.

B. Wood Cladding: Kiln-dried softwood siding conforming to the following:

1. Basis-of-Design: Subject to compliance with requirements, provide Briza Atlantic White Cedar as manufactured by reSawn Timber Co.; www.resawntimber.com.
2. Species: Atlantic White Cedar.
3. Grade: Select Tight Knot.
4. Pattern: Smooth-faced tongue and groove, actual face width (coverage) and thickness of 5-1/8 by 3/4 inch.

C. Panel Attachment System: Manufacturer's steel attachment system designed for installation of wall and soffit cladding over continuous insulation with concealed and exposed fasteners.

1. Framing: Extruded aluminum, ASTM B 221/B 221M, Alloy 6063-T6 or 6061-T6; designed to withstand indicated design loads.
2. Fasteners: Stainless steel, type recommended by manufacturer for intended use.

2.2 ACCESSORIES

A. Continuous Insulation: As specified in Section 072100 “Thermal Insulation.”

B. Flashings and Trim: Stainless steel sheet, as specified in Section 076200 “Sheet Metal Flashing and Trim."

C. Sealants: Silicone type, as specified in Section 079200 “Joint Sealants.”

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, Sintered Stone supports, and other conditions affecting performance of the Work.

B. Examine wall framing to verify that girts, angles, channels, studs, and other structural cladding support members and anchorage have been installed within alignment tolerances required by cladding manufacturer.

C. Examine wall sheathing and air barrier to verify that sheathing joints are supported by framing or blocking, air barrier is installed, and that substrate is within flatness tolerances required by cladding manufacturer.

D. Verify compatibility of different metallic surfaces in contact with each other and protect against electro-chemical corrosion.

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

3.2 PREPARATION

A. Cladding Attachment Systems: Install subframing, furring, attachment systems, and other miscellaneous cladding support members and anchorages according to ASTM C 754 and manufacturer's written instructions.

B. Thermal Insulation: After installing cladding attachment systems, install insulation over air barrier in accordance with Section 072100 “Thermal Insulation.”

C. Verify that penetrations through the air barrier from cladding attachment systems have been repaired.

3.3 INSTALLATION

A. Install cladding in accordance with manufacturer’s written instructions and approved shop drawings, perpendicular to supports; fasten cladding securely, allowing for thermal movement.

1. Install fasteners exposed to view in finished construction with even spacing and alignment.

B. Do not cut, or trim component parts in a manner which would damage finish, decrease strength, or result in visual imperfection or failure of performance.

C. Separate dissimilar metals and use gasketed fasteners, isolation shims, or isolation tape where needed to eliminate corrosive or electrolytic action between metals.

D. Before installing cladding, verify that penetrations through the air barrier from cladding attachment systems are repaired in accordance with air barrier manufacturer's instructions.

3.4 ERECTION TOLERANCES

A. Cladding Installation Tolerances: Install cladding plumb and level per manufacturer’s recommendations and guidelines and engineering tolerances for necessary movements and structural support.

3.5 CLEANING AND PROTECTION

A. Remove temporary protective coverings and strippable films, if any, as cladding is installed, unless otherwise indicated in manufacturer's written installation instructions. On completion, clean finished surfaces as recommended by manufacturer. Maintain in a clean condition during construction.

B. Replace Cladding that has been damaged or has deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION

SECTION 074264 - METAL COMPOSITE MATERIAL (MCM) WALL PANELS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Metal composite material (MCM) wall panels.

B. Related Sections:

1. Section 054000 - Cold Framed Metal Framing: Panel support framing.
2. Section 072726 - Air Barriers: Weather barrier in cavity behind wall system.
3. Section 079200 - Joint Sealants.

1.2 ADMINISTRATIVE REQUIREMENTS

A. Pre-Installation Meeting: Convene one week before starting work of this section to verify project requirements, co-ordinate with installers of other work, establish condition and completeness of building substrate, and review manufacturers' installation instructions and warranty requirements.

1. Require attendance by the installer and relevant sub-contractors.
2. Include MCM sheet manufacturer’s representative and wall system manufacturer’s representative to review storage and handling procedures.
3. Review in detail truck transportation, parking, vertical transportation, schedule, personnel, installation of adjacent materials and substrate.
4. Review procedures for protection of work and other construction.

1.3 SUBMITTALS

A. Product Data - MCM Sheets: Manufacturer's data sheets on each product to be used, including thickness, physical characteristics, and finish, and:

1. Finish manufacturer's data sheet showing physical and performance characteristics.
2. Storage and handling requirements and recommendations.
3. Fabrication instructions and recommendations.
4. Specimen warranty for finish, as specified herein.

B. Product Data - Wall System: Manufacturer's data sheets on each product to be used, including:

1. Physical characteristics of components shown on shop drawings.
2. Storage and handling requirements and recommendations.
3. Installation instructions and recommendations.
4. Specimen warranty for wall system, as specified herein.

C. Shop Drawings: Show layout and elevations, dimensions and thickness of panels, connections, details and location of joints, sealants and gaskets, method of anchorage, number of anchors, supports, reinforcement, trim, flashings, and accessories.

1. Indicate panel numbering system.
2. Differentiate between shop and field fabrication.
3. Indicate substrates and adjacent work with which the wall system must be coordinated.

4. Include large-scale details of anchorages and connecting elements.
5. Include large-scale details or schematic, exploded or isometric diagrams to fully explain flashing at a scale of not less than 1-1/2 inches per 12 inches.

D. Verification Samples: For each finish product specified, minimum size 12 inches square, representing actual product in color and texture.

E. Installer’s Qualifications.

F. Test Reports: Indicating compliance with NFPA 285 requirements, where applicable.

G. Certificate: Certify that the products and work results of this section meet or exceed specified requirements.

H. Manufacturer's Field Reports: Provide within 48 hours of field review. State what was observed and what changes, if any, were requested or required.

I. Maintenance Data: Care of finishes and warranty requirements.

J. Executed Warranty: Submit warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.4 QUALITY ASSURANCE

A. Field Measurements: Verify actual dimensions by field measurement before fabrication; show recorded measurements on shop drawings.

B. Wall System Manufacturer Qualifications: Company specializing in manufacturing products specified in this section.

1. With not less than five years of experience.
2. Approved by MCM sheet manufacturer.

C. Installer Qualifications: Company specializing in performing work of the type specified in this section.

1. With minimum five years of documented experience.
2. Approved by wall system manufacturer.

D. Mock-Up: Provide a mock-up for evaluation of fabrication workmanship.

1. Locate where directed.
2. Provide panels finished as specified. Include back-up material as detailed and weather-barrier and flashings.
3. Mock-up may not remain as part of the Work.

E. Pre-Installation Meeting: Convene one week before starting work of this section to verify project requirements, co-ordinate with installers of other work, establish condition and completeness of building substrate, and review manufacturers' installation instructions and warranty requirements.

1. Require attendance by the installer and relevant sub-contractors.
2. Include MCM sheet manufacturer’s representative and wall system manufacturer’s representative to review storage and handling procedures.
3. Review in detail truck transportation, parking, vertical transportation, schedule, personnel, installation of adjacent materials and substrate.
4. Review procedures for protection of work and other construction.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver products in manufacturer's original, unopened, undamaged containers with identification labels intact.

1. Protect finishes by applying heavy duty removable plastic film during production.
2. Package for protection against transportation damage.
3. Provide markings to identify components consistently with drawings.
4. Exercise care in unloading, storing and installing panels to prevent bending, warping, twisting and surface damage.

B. Store products protected from exposure to harmful weather conditions and at temperature conditions recommended by manufacturer.

1. Store in well ventilated space out of direct sunlight.
2. Protect from moisture and condensation with tarpaulins or other suitable weather tight covering installed to provide ventilation.
3. Store at a slope to ensure positive drainage of any accumulated water.
4. Do not store in any enclosed space where ambient temperature can exceed 120 degrees F.
5. Avoid contact with any other materials that might cause staining, denting, or other surface damage.

1.6 COORDINATION

A. Coordinate metal wall panel assemblies with rain drainage work, flashing, trim, and construction of studs, soffits, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

1.7 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of MCM wall panel assemblies that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:
   a. Structural failures including rupturing, cracking, or puncturing.
   b. Deterioration of metals and other materials beyond normal weathering.

2. Warranty Period: Two years from date of Substantial Completion.

B. Special Warranty on Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace MCM wall panels that show evidence of deterioration of factory-applied finishes within specified warranty period.

1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:
   a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
   b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
   c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

2. Finish Warranty Period: 20 years from date of Substantial Completion.

C. Special Weathertightness Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace MCM wall panel assemblies that fail to remain weathertight, including leaks, within specified warranty period.

1. Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design: Subject to compliance with requirements, provide Alpolic/fr as manufactured by Alpolic Materials, or comparable by one of the following:

1. Alcan Composites USA, Inc. (Alucobond).
2. Arconic Architectural Products (Reynobond).
3. Armetco Systems, Inc.

2.2 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design MCM wall panel assembly, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. Structural Performance: Provide metal composite material panel systems capable of withstanding the effects of the following loads, based on testing according to ASTM E 330:

1. Wind Loads: As indicated on Drawings.
2. Deflection Limits: For wind loads, no greater than 1/180 of the span.

C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

D. Provide continuity of air barrier seal at building enclosure elements in conjunction with air barrier materials specified in Section 072726.

E. Fire Propagation Characteristics - Test wall panels with all combustible components of the exterior wall assembly, including air barrier, for compliance with NFPA 285 requirements.

2.3 WALL PANEL SYSTEM

A. Metal Composite Material Wall Panel Systems: Provide factory-formed and -assembled, metal composite material wall panels fabricated from two metal facings that are bonded to a solid, extruded thermoplastic core; formed into profile for installation method indicated. Include attachment assembly components, panel stiffeners, and accessories required for weathertight system.

B. Aluminum-Faced Composite Wall Panels: Formed with 0.020-inch- thick, coil-coated aluminum sheet facings.

1. Panel Thickness: 0.157 inch (4 mm), minimum.
2. Core: Fire retardant.
3. Exterior Finish: Metallic fluoropolymer.
   a. Color: As selected by Architect.

C. Attachment Assembly: Manufacturer's standard Rout and Return Dry system, providing panel jointing and weatherseal using reveal joints and gaskets, but no sealant.

2.4 MISCELLANEOUS MATERIALS

A. Miscellaneous Metal Subframing and Furring: ASTM C 645, cold-formed, metallic-coated steel sheet ASTM A 653/A 653M, G90 coating designation or ASTM A 792/A 792M, Class AZ50 aluminum-zinc-alloy coating designation unless otherwise indicated. Provide manufacturer's standard sections as required for support and alignment of metal composite material panel system.

B. Panel Accessories: Provide components required for a complete, weathertight panel system including trim, copings, fasciae, mullions, sills, corner units, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal composite material panels unless otherwise indicated.

C. Flashing and Trim: Provide flashing and trim formed from same material as metal composite material panels as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, bases, drips, sills, jambs, corners, endwalls, framed openings, rakes, fasciae, parapet caps, soffits, reveals, and fillers. Finish flashing and trim with same finish system as adjacent metal composite material panels.

D. Panel Fasteners: Self-tapping screws designed to withstand design loads. Provide exposed fasteners with heads matching color of metal composite material panels by means of plastic caps or factory-applied coating. Provide EPDM or PVC sealing washers for exposed fasteners.

E. Panel Sealants: ASTM C 920; elastomeric silicone sealant as specified in Section 079200 “Joint Sealants;” of type, grade, class, and use classifications required to seal joints in metal composite material panels and remain weathertight; and as recommended in writing by metal composite material panel manufacturer.

F. Air Barrier: Vapor permeable fluid-applied air barrier membrane, with sealant, membrane flashing material, and all accessories necessary for complete installation in accordance with Section 072726 “Air Barriers.”

1. Air barrier shall be a component of a NFPA 285-compliant wall assembly.

G. Insulation: Mineral wool board meeting the requirements of rainscreen insulation specified in Section 072100 “Thermal Insulation,” with thickness as required to meet thermal value indicated on Drawings.

2.5 FABRICATION

A. General: Fabricate and finish metal composite material panels and accessories at the factory, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.

B. Fabricate metal composite material panel joints with factory-installed captive gaskets or separator strips that provide a weathertight seal and prevent metal-to-metal contact, and that minimize noise from movements.

C. Include all sub-girts, zee-clips, base and sill angles and channels, hat-shaped and rigid channels, and furring channels required for complete installation.

1. Provide material strength, dimensions, configuration as required to meet the applied loads applied and in compliance with applicable building code.
2. Sheet Steel Components: ASTM A653/A653M galvanized to G90/Z275 or zinc-iron alloy-coated to A60/ZF180; or ASTM A792/A792M aluminum-zinc coated to AZ60/AZM180.
3. Stainless Steel Sheet Components: ASTM A480/A480M.
4. Aluminum Components: ASTM B209 or B 221.

D. Sheet Metal Flashing and Trim: Fabricate flashing and trim in accordance with Section 076200 “Sheet Metal Flashing and Trim” and the following:

1. Fabricate integrated flashings and trim from sheet aluminum; 0.040 inch thick, minimum; finish and color to match MCM sheet.
2. Form exposed sheet metal accessories that are without excessive oil canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.
3. Seams for Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints for additional strength.
4. Seams for Other Than Aluminum: Fabricate nonmoving seams in accessories with flat-lock seams. Tin edges to be seamed, form seams, and solder.
5. Sealed Joints: Form non-expansion, but movable, joints in metal to accommodate sealant and to comply with SMACNA standards.
6. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of accessories exposed to view.
7. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal recommended in writing by metal panel manufacturer.

E. Panel Fabrication: One inch deep pans formed of metal composite material sheet by routing back edges of sheet, removing corners, and folding edges.

1. Reinforce corners.
2. Provide concealed attachment to supporting structure by adhering attachment members to back of panel; attachment members may also function as stiffeners.
3. Maintain maximum panel bow of 0.8 percent of panel dimension in width and length; provide stiffeners of sufficient size and strength to maintain panel flatness without showing local stresses or read-through on panel face.
4. Reinforce panels over 36 inches long with metal angle braces 24 inches on center in short direction.
5. Secure members to back face of panels using structural silicone sealant approved by MCM sheet manufacturer.
6. Metallic Finished Panels: Maintain consistent grain of MCM sheet; specifically, do not rotate sheet purely to avoid waste.
7. Fabricate panels under controlled shop conditions.
8. Where final dimensions cannot be established by field measurement before commencement of manufacturing, make allowance for field adjustments without requiring field fabrication of panels.
9. Fabricate as indicated on drawings and as recommended by MCM sheet manufacturer.
   a. Make panel lines, breaks, curves and angles sharp and true.
   b. Keep plane surfaces free from warp or buckle.
   c. Keep panel surfaces free of scratches or marks caused during fabrication.
10. Provide joint details providing a watertight and structurally sound wall panel system that allows no uncontrolled water penetration on inside face of panel system.

11. For "dry" jointing, secure extrusions to returned pan edges with stainless steel rivets; provide means of concealed drainage with baffles and weeps for water that might accumulate in members of system.

2.6 FINISHES

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

1. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

C. Aluminum Panels and Accessories:

1. Two-coat fluoropolymer finish complying with AAMA 2605 and containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
2. Concealed Finish: Apply pretreatment and manufacturer's standard white or light-colored acrylic or polyester backer finish consisting of prime coat and wash coat with a minimum total dry film thickness of 0.5 mil.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify dimensions, tolerances, and interfaces with other work.

B. Verify substrate on-site to determine that conditions are acceptable for product installation in accordance with manufacturers written instructions.

C. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

D. Notify Architect in writing of conditions detrimental to proper and timely completion of work. Do not proceed with erection until unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Protect adjacent work areas and finish surfaces from damage during installation.

B. Deliver anchorage items to be cast into concrete or built into masonry to appropriate installer(s) together with setting templates.

3.3 INSTALLATION

A. Do not install products that are defective, including warped, bowed, dented, and broken members, and members with damaged finishes.

B. Comply with instructions and recommendations of MCM sheet manufacturer and wall system manufacturer, as well as with approved shop drawings.

C. Install wall system securely allowing for necessary thermal and structural movement; comply with wall system manufacturer's instructions for installation of concealed fasteners.

D. Do not handle or tool products during erection in manner that damages finish, decreases strength, or results in visual imperfection or failure in performance. Return component parts that require alteration to shop for refabrication, if possible, or for replacement with new parts.

E. Do not form panels in field unless required by wall system manufacturer and approved by the Architect; comply with MCM sheet manufacturer's instructions and recommendations for field forming.

F. Separate dissimilar metals; use gasket fasteners, isolation shims, or isolation tape where needed to eliminate possibility of electrolytic action between metals.

G. Where joints are designed for field applied sealant, seal joints completely with specified sealant.

H. Install flashings as indicated on shop drawings At flashing butt joints, provide a lap strap under flashing and seal lapped surfaces with a full bed of non-hardening sealant.

I. Install square, plumb, straight, and true, accurately fitted, with tight joints and intersections maintaining the following installation tolerances:

1. Variation From Plane or Location: 1/2 inch in 30 feet of length and up to 3/4 inch in 300 feet, maximum.
2. Deviation of Vertical Member From True Line: 0.1 inch in 25 feet run, maximum.
3. Deviation of Horizontal Member From True Line: 0.1 inch in 25 feet run, maximum.
4. Offset From True Alignment Between Two Adjacent Members Abutting End To End, In Line: 0.03 inch, maximum.

J. Replace damaged products.

1. Exception: Field repairs of minor damage to finishes may be permitted only when approved in writing by Architect, panel manufacturer, and fabricator.
2. Field Repairs to Finishes: Using materials and methods sufficient that repairs are not discernible when viewed at distance of 10 feet under all typical light conditions experienced at the project.

3.4 FIELD QUALITY CONTROL

A. Wall System Manufacturer's Field Services: Provide field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with instructions.

B. Site Visits: Schedule two site visits during execution of installation.

3.5 CLEANING

A. Ensure weep holes and drainage channels are unobstructed and free of dirt and sealants.

B. Remove protective film after installation of joint sealers, after cleaning of adjacent materials, and immediately prior to completion of work.

C. Remove temporary coverings and protection of adjacent work areas.

D. Clean installed products in accordance with manufacturer's instructions.

3.6 PROTECTION

A. Protect installed panel system from damage during construction.

END OF SECTION

SECTION 075216 – SBS MODIFIED BITUMINOUS MEMBRANE ROOFING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Work includes all labor, materials, equipment and services necessary for installation of torch-applied SBS modified bituminous membrane roofing system.

B. Related Sections include the following:

1. Division 07 Section “Roof Board Insulation.”
2. Division 07 Section “Sheet Metal Flashing and Trim.”

1.2 REFERENCES

A. American Society of Civil Engineers (ASCE):

1. ASCE 7-05, Minimum Design Loads for Buildings and Other Structures.

B. American Society for Testing and Materials (ASTM):

1. ASTM D41 Standard Specification for Asphalt Primer Used in Roofing, Damp Proofing and Waterproofing.
2. ASTM D312 Standard Specification for Asphalt Used in Roofing.
3. ASTM D451 Standard Test Method for Sieve Analysis of Granular Mineral Surfacing for Asphalt Roofing Products.
4. ASTM D1079 Standard Terminology Relating to Roofing, Waterproofing and Bituminous Materials.
5. ASTM D1227 Standard Specification for Emulsified Asphalt used as a Protective Coating for Roofing.
6. ASTM D1863 Standard Specification for Mineral Aggregate used as a Protective Coating for Roofing.
7. ASTM D2178 Standard Specification for Asphalt Glass Felt used as a Protective Coating for Roofing.
8. ASTM D2822 Standard Specification for Asphalt Roofing Cement.
9. ASTM D2824 Standard Specification for Aluminum-pigmented Asphalt Roof Coating.
10. ASTM D4601 Standard Specification for Asphalt Coated Glass Fiber Base Sheet used in Roofing.
11. ASTM D5147 Standard Test Method for Sampling and Testing Modified Bituminous Sheet Materials.
12. ASTM D6162 Standard Specification for Styrene Butadiene Styrene (SBS) Modified Bituminous Sheet Materials using a combination of Polyester and Glass Fiber Reinforcements.
13. ASTM D6163 Standard Specification for Styrene Butadiene Styrene (SBS) Modified Bituminous Sheet Materials using Glass Fiber Reinforcements.
14. ASTM E108 Standard Test Methods for Fire Test of Roof Coverings.

C. Factory Mutual Research (FM):

1. Roof Assembly Classifications.

D. National Roofing Contractors Association (NRCA):

1. Roofing and Waterproofing Manual.

E. Underwriters Laboratories, Inc. (UL):

1. Fire Hazard Classifications.

F. Warnock Hersey (WH):

1. Fire Hazard Classifications.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Pre-installation Meeting: Conduct at Project Site.

1. Meet with Owner, Architect, Owner's insurer if applicable, testing and inspecting agency representative, roofing Installer, roofing system manufacturer's representative, deck Installer, and installers whose work interfaces with or affects roofing, including installers of roof accessories and roof-mounted equipment.
2. Review methods and procedures related to roofing installation, including set up and mobilization areas for stored material and work area.
3. Review and finalize construction schedule, and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
4. Examine deck substrate conditions and finishes for compliance with requirements, including flatness and fastening.
5. Review structural loading limitations of roof deck during and after roofing.
6. Review base flashings, special roofing details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that affects roofing system.
7. Review governing regulations and requirements for insurance and certificates if applicable.
8. Review temporary protection requirements for roofing system during and after installation.
9. Review roof observation and repair procedures after roofing installation.
10. Review notification procedures for weather or non-working days.

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this Section with not less than 15 years documented experience and have ISO 9001 certification.

B. Installer Qualifications: Company specializing in modified bituminous roofing installation with not less than 5 years experience and authorized by roofing system manufacturer as qualified to install manufacturer's roofing materials.

C. Installer's Field Supervision: Maintain a full-time Supervisor/Foreman on job site during all phases of roofing work while roofing work is in progress. Supervisor/Foremen must be fluid in the English language and maintain proper supervision of workmen.

D. Maintain a copy of the Contract Documents in the possession of the Supervisor/Foreman and on the roof at all times.

E. Source Limitations: Obtain all components of roof system from a single manufacturer, including roll goods materials specified in Section 074113 “Metal Roof Panels”. Secondary products that are required shall be recommended and approved in writing by the roofing system Manufacturer.

1. Upon request of the Architect or Owner, submit Manufacturer's written approval of secondary components in list form, signed by an authorized agent of the Manufacturer.
2. Manufacturer shall have direct authority and control over all fabrication of steel components as well as the raw materials used in their fabrication.

F. Source Quality Control: Manufacturer shall have in place a documented, standardized quality control program such as ISO-9001 approval.

G. Engage the Manufacturer's Field Representative to conduct required periodic inspections of work in progress as described herein and shall furnish written documentation of all such inspections.

H. Manufacturer shall provide the project Owner with a written statement that they will provide site inspections three days per week that confirms that the project is being constructed as specified, by an experienced, full time employee of the company.

1.5 SUBMITTALS

A. Comply with pertinent provisions of Division 01 Section “Submittal Procedures, unless otherwise indicated.”

B. Manufacturer's Installation Instructions: Submit installation instructions and recommendations indicating special precautions required for installing the membrane.

C. Manufacturer's Certificate: Certify that roof system furnished is approved by Factory Mutual, Underwriters Laboratories, Warnock Hersey or approved third party testing facility in accordance with ASTM E108, Class [A] for external fire and meets local or nationally recognized building codes.

D. Manufacturer's Certificate: Certify that the roof system furnished is approved or accepted by Factory Mutual Approval Standard 4470.

E. Manufacturer's Certificate: Certify that materials are manufactured in the United States and conform to requirements specified herein, are chemically and physically compatible with each other, and are suitable for inclusion within the total roof system specified herein.

F. Manufacturer's Certificate: Submit a certified copy of the roofing manufacturer's ISO 9001 compliance certificate.

G. Test Reports: Submit test reports, prepared by an independent testing agency, for all modified bituminous sheet roofing, indicating compliance with ASTM D5147.

H. Written certification from the roofing system manufacturer certifying the applicator is currently authorized for the installation of the specified roof system.

I. Design Loads: Submit copy of manufacturer's minimum design load calculations according to ASCE 7-05, Method 2 for Components and Cladding, sealed by a registered professional engineer. In no case shall the design loads be taken to be less than those detailed in Design and Performance Criteria article of this specification.

J. Specimen Warranty: Provide an unexecuted copy of the warranty specified for this Project, identifying the terms and conditions required of the Manufacturer and the Owner.

1.6 CLOSEOUT SUBMITTALS

A. General: Comply with Requirements of Division 01 Section Closeout Submittals.

B. Special Project Warranty: Provide specified warranty for the Project, executed by the authorized agent of the Manufacturer.

C. Roofing Maintenance Instructions: Provide a manual of manufacturer's recommendations for maintenance of installed roofing systems.

1.7 DELIVERY, STORAGE AND HANDLING

A. Deliver roofing materials to Project site in original containers with seals unbroken and labeled with manufacturer's name, product brand name and type, date of manufacture, approval or listing agency markings, and directions for storing and mixing with other components.

B. Store liquid materials in their original undamaged containers in a clean, dry, protected location and within the temperature range required by roofing system manufacturer. Protect stored liquid material from direct sunlight.

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

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

D. Handle and store roofing materials, and place equipment in a manner to avoid permanent deflection of deck.

1.8 WARRANTY

A. Upon completion of installation, and acceptance by the Owner and Architect, the Manufacturer will supply to the Owner an “NDL” warranty, without monetary limitations in which manufacturer agrees to repair or replace components of roofing system that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Thirty (30) years from date of Substantial Completion.

B. Installer’s Warranty: Provide roofing installers warranty, to the membrane manufacturer, in which the roofing installer will, at his own expense, make or cause to be made such repairs to or replacements of said work as are necessary to correct faulty and defective work and as are necessary to maintain said work in a watertight condition.

1. Warranty Period: Two (2) years from date of Substantial Completion.

C. The Roof System Manufacturer shall provide annual inspection of the roof for the duration of the warranty at no fee to the Owner.

1.9 MANUFACTURER'S FIELD REPRESENTATION

A. Manufacturer's Field Representative: An authorized, full-time employee of the roof system manufacturer shall be assigned to the project to conduct field observations during the installation phase.

B. Regularly scheduled site observations shall be required by the manufacturer's field representative a minimum of three (3) days per week during the roofing installation period; exceptions being made for inclement weather, holidays, etc.

C. Observation reports shall include the following:

1. Written report/documentation of the installation progress at the time of the site visit to be delivered to the architect and owner within 48 hours of the site visit.
2. This report shall include documentation of any issues/question and resolution.
3. This report shall include record of directives given to the roofing contractor.
4. Digital photographic documentation of the roofing progress; including documentation of specific issues and areas of concern.
5. Each report shall contain project name, architect's project number, and date/time/duration of site visit.

D. In addition to the progress observations, the manufacturer's representative must:

1. Attend the roofing trade start-up meeting.
2. Inspect and approve the roof substrate/deck prior to the start of roofing work.

E. All observation reports shall be kept current and shall be delivered electronically to the architect and contractor within five (5) calendar days after the observation. Progress payments for roofing work may be withheld if observation report submissions are not current.

F. After completion of all roofing work, and prior to acceptance of the roofing installation, the manufacturer's representative shall conduct an observation to document all roofing work to be corrected as a condition of acceptance.

1. Each item requiring corrective work shall be identified (including specific location) and required corrective action shall be noted.
2. The final observation report must be produced in writing with photographic back-up. Marking corrective items on the roof alone shall not be acceptable.

G. Any failure by the Architect, the Owner's Representative, the Project Manager, or the roofing manufacturer's Technical Field Representative to observe, detect, pinpoint, or object to any defect or noncompliance with the requirements of the Roofing Manufacturer's requirements, the Contract Documents, the Project Specifications, the approved Shop Drawings and Engineering Data, and/or the Roofing Manufacturer's standard details – of work in progress or completed work – shall not relieve the Contractor of, or reduce, or in any way limit, his responsibility of full performance of the work required of him under the requirements of the Roofing Manufacturer, the Contract Documents, the Project Specifications, the approved Shop Drawings and Engineering Data, and/or the Roofing Manufacturer's standard details

1.10 FIELD CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit roofing system to be installed according to manufacturer's written instructions and warranty requirements.

B. Do not apply roofing insulation or membrane to damp deck surface.

C. Do not expose materials subject to water or solar damage in quantities greater than can be weatherproofed during same day.

D. Phased Construction will not be accepted.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis of Design Manufacturer: **The Garland Company, Inc.**

1. 3800 East 91st Street, Cleveland, OH, 44105
2. Manufacturer's Representative:
   a. Blake Dieste; bdieste@garlandind.com; (M) 832-488-4783

B. Modified bituminous roofing shall include but not be limited to:

1. Base Ply Sheet Modified Membrane: Type II membrane complying with ASTM 6163, Grade S. Physical requirements below.
2. Cap Ply Sheet Modified Membrane: Type III membrane complying with ASTM 6163, Grade G. Physical requirements below.
3. Stripping Ply Sheet Modified Membrane: Type II membrane complying with ASTM 6163, Grade S. Physical requirements below.
4. Base Flashing Assembly: Two ply modified, heat fused with the finished ply meeting Type III membrane complying with ASTM 6163, Grade G minimum requirements and base ply meeting Type II membrane complying with ASTM 6163, Grade S minimum.

C. Basis of Design Materials, manufacturer's product designations, and/or manufacturer's names specified herein shall be regarded as the minimum standard of quality required for work of this Section. Comply with all manufacturer and contractor/fabricator quality and performance criteria specified in Part 1.

D. Substitutions: Products proposed as equal to the products specified in this Section shall be submitted in accordance with Bidding Requirements and Division 01 provisions.

1. Proposals shall be accompanied by a copy of the manufacturer's standard specification section. That specification section shall be signed and sealed by a professional engineer licensed in the state in which the installation is to take place. Substitution requests containing specifications without licensed engineer certification shall be rejected for non-conformance.
2. Include a list of three (3) projects of similar type and extent, located within a twenty-five (25)-mile radius from the location of the project. In addition, the three projects must be at least five (5) years old and be available for inspection by the Architect, Owner or Owner's Representative.
3. Provide all submittal information for the proposed substitution as specified in Article 1.06 of this specification section.
4. Equivalency of performance criteria, warranty terms as described in Article 1.09 of this specification section, submittal procedures, and contractual terms will constitute the basis of acceptance.

2.2 ROOFING SHEET MATERIALS

A. Base Ply Sheet Modified Membrane: ASTM D 6163, Grade S, Type II, 110 mil SBS-modified asphalt sheet; suitable for application method specified, and as follows: HPR Torchbase by The Garland Company, Inc.

1. Tensile Strength, ASTM D 5147:
   a. 2 in/min. @ 73.4 +/- 3.6 deg. F MD 210 lbf/in XD 210 lbf/in
   b. 50 mm/min. @ 23 +/- 2 deg. C MD 36.75 kN/m XD 36.75 kN/m

2. Tear Strength, ASTM D 5147:
   a. 2 in/min. @ 73.4 +/- 3.6 deg. F MD 250 lbf XD 250 lbf
   b. 50 mm/min. @ 23 +/- 2 deg. C MD 1112N XD 1112N

3. Elongation at Maximum Tensile, ASTM D 5147:
   a. 2 in/min. @ 73.4 +/- 3.6 deg. F MD 4.0% XD 4.0%
   b. 50 mm/min. @ 23 +/- 2 deg. C MD 4.0% XD 4.0%

4. Low Temperature Flexibility, ASTM D5147, Passes -35 deg. F (-37 deg. C)

B. Granule-Surfaced Roofing Cap Sheet: ASTM D 6163, Grade G, Type III, 195 mil SBS-modified asphalt sheet with fiberglass and polyester composite scrim; suitable for application method specified, and as follows: Stressply IV Plus UV Mineral by The Garland Company, Inc.

1. Tensile Strength, ASTM D 5147:
   a. 2 in/min. @ 73.4 +/- 3.6 deg. F MD 310 lbf/in XD 310 lbf/in
   b. 50 mm/min. @ 23 +/- 2 deg. C MD 54.25 kN/m XD 54.25 kN/m

2. Tear Strength, ASTM D 5147:
   a. 2 in/min. @ 73.4 +/- 3.6 deg. F MD 510 lbf XD 510 lbf
   b. 50 mm/min. @ 23 +/- 2 deg. C MD 2269 N XD 2269 N

3. Elongation at Maximum Tensile, ASTM D 5147:
   a. 2 in/min. @ 73.4 +/- 3.6 deg. F MD 6% XD 6%
   b. 50 mm/min. @ 23 +/- 2 deg. C MD 6% XD 6%

4. Low Temperature Flexibility, ASTM D 5147, Passes -40 deg. F (-40 deg. C)
5. Granule Color: White.

2.3 BASE FLASHING SHEET MATERIALS

A. Base Ply Sheet Modified Membrane: ASTM D 6163, Grade S, Type II, 110 mil SBS-modified asphalt sheet; suitable for application method specified, and as follows: HPR Torchbase by The Garland Company, Inc.

1. Tensile Strength, ASTM D 5147:
   a. 2 in/min. @ 73.4 +/- 3.6 deg. F MD 210 lbf/in XD 210 lbf/in
   b. 50 mm/min. @ 23 +/- 2 deg. C MD 36.75 kN/m XD 36.75 kN/m

2. Tear Strength, ASTM D 5147:
   a. 2 in/min. @ 73.4 +/- 3.6 deg. F MD 250 lbf XD 250 lbf
   b. 50 mm/min. @ 23 +/- 2 deg. C MD 1112N XD 1112N

3. Elongation at Maximum Tensile, ASTM D 5147:
   a. 2 in/min. @ 73.4 +/- 3.6 deg. F MD 4.0% XD 4.0%
   b. 50 mm/min. @ 23 +/- 2 deg. C MD 4.0% XD 4.0%

4. Low Temperature Flexibility, ASTM D5147, Passes -35 deg. F (-37 deg. C)

B. Granule-Surfaced Roofing Cap Sheet: ASTM D 6163, Grade G, Type III, 195 mil SBS-modified asphalt sheet with fiberglass and polyester composite scrim; suitable for application method specified, and as follows: Stressply IV Plus UV Mineral by The Garland Company, Inc.

1. Tensile Strength, ASTM D 5147:
   a. 2 in/min. @ 73.4 +/- 3.6 deg. F MD 310 lbf/in XD 310 lbf/in
   b. 50 mm/min. @ 23 +/- 2 deg. C MD 54.25 kN/m XD 54.25 kN/m
2. Tear Strength, ASTM D 5147:
   a. 2 in/min. @ 73.4 +/- 3.6 deg. F MD 510 lbf XD 510 lbf
   b. 50 mm/min. @ 23 +/- 2 deg. C MD 2269 N XD 2269 N
3. Elongation at Maximum Tensile, ASTM D 5147:
   a. 2 in/min. @ 73.4 +/- 3.6 deg. F MD 6% XD 6%
   b. 50 mm/min. @ 23 +/- 2 deg. C MD 6% XD 6%
4. Low Temperature Flexibility, ASTM D 5147, Passes -40 deg. F (-40 deg. C)
5. Granule Color: White.

2.4 BITUMINOUS ROOFING MATERIALS

A. General: Auxiliary materials provided or recommended by roofing system manufacturer for intended use and compatible with roofing.

B. Liquid Flashing - Tuff-Flash: An asphaltic-polyurethane, low odor, liquid flashing material designed for specialized details unable to be waterproofed with typical modified membrane flashings.

C. Asphalt Primer: ASTM D 41/D 41M. Garla-Prime by The Garland Company, Inc.

D. Asphalt Roofing Cement: ASTM D 4586, asbestos free, of consistency required by roofing system manufacturer for application. Flashing-Bond by The Garland Company, Inc.

E. Mastic Sealant: Polyisobutylene, plain or modified bitumen; non-hardening, non-migrating, non-skinning, and non-drying. Garla-Flex by The Garland Company, Inc.

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

2.5 SURFACING

A. Roofing Granules: Ceramic-coated roofing granules as provided by the prime material manufacturer, No. 11 screen size with 100 percent passing No. 8 sieve and 98 percent of mass retained on No. 40 sieve, color to match roofing.

B. Reflective Roof Coating: Water-based Acrylic with self-curing Latex Polymers. Pyramic by The Garland Company, Inc.

2.6 RELATED MATERIALS

A. Plumbing stacks should be 4lb sheet lead formed and rolled.

B. Nails and Fasteners: Non-ferrous metal or galvanized steel, except that hard copper nails shall be used with copper; aluminum or stainless steel nails shall be used with aluminum; and stainless steel nails shall be used with stainless steel. Fasteners shall be self-clinching type of penetrating type as recommended by the manufacturer of the deck material. Nails and fasteners shall be flush-driven through flat metal discs of not less than one (1) inch diameter. Omit metal discs when one-piece composite nails or fasteners with heads not less than one (1) inch diameter are used.

C. Butyl Tape: 100% solids, asbestos free and compressive tape designed to seal as recommended and furnished by the membrane manufacturer.

D. Insulation Adhesive: As provided by the prime roof membrane manufacturer and specified in Division 7 “Roof Board Insulation.”.

2.7 PERFORMANCE REQUIREMENTS

A. General Performance: Installed roofing and base flashings shall withstand specified uplift pressures, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Roofing and base flashings shall remain watertight.

B. Material Compatibility: Roofing materials shall be compatible with one another and adjacent materials under conditions of service and application required, as demonstrated by roofing manufacturer based on testing and field experience.

C. Solar Reflectance Index: Not less than 70 when calculated according to ASTM E 1980, based on testing identical products by a qualified testing agency.

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

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

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

A. Cooperate with manufacturer, inspection and test agencies engaged or required to perform services in connection with installing the roof system.

B. Insurance/Code Compliance: Where required by code, install and test the roofing system to comply with governing regulation and specified insurance requirements.

C. Protect other work from spillage of roofing materials and prevent materials from entering or clogging drains and conductors. Replace or restore other work damaged by installation of the modified bituminous roofing system.

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

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

E. Substrate Joint Penetrations: Prevent bitumen from penetrating substrate joints, entering building, or damaging roofing system components or adjacent building construction.

F. Apply roofing materials as specified by manufacturer's instructions:

1. Keep roofing materials dry before and during application.
2. Do not permit phased construction.
3. Complete application of roofing plies, modified sheet and flashing in a continuous operation.
4. Begin and apply only as much roofing in one day as can be completed that same day.

G. Cut-Offs (Waterstops): At end of each day's roofing installation, protect exposed edge of incomplete work, including ply sheets and insulation.

H. Broadcast minerals into the bleed out of bitumen while bitumen is at its recommended EVT temperature to achieve a monolithic appearance.

3.2 EXAMINATION

A. Verify that deck surfaces and project conditions are ready to receive work of this Section.

B. Verify that deck is supported and secured to structural members.

C. Verify that deck is clean and smooth, free of depressions, projections or ripples, and is properly sloped.

D. Verify that adjacent roof substrate components do not vary more than [¼] inch in height.

E. Verify that deck surfaces are dry.

F. Verify that openings, curbs, pipes, conduit, sleeves, ducts, and other items which penetrate the roof are set solidly, and that cant strips, wood nailing strips, and reglets are set in place.

3.3 SBS MODIFIED BITUMINOUS BASE PLY MEMBRANE INSTALLATION

A. Install base ply according to roofing manufacturer's written instructions, starting at low point of roofing system. Extend roofing membrane sheets over and terminate beyond cants, installing as follows:

1. Lay out the roll in the course to be followed and unroll 6 feet.
2. Using a roofing torch, heat the surface of the coiled portion until the burn-off backer melts away. At this point, the material is hot enough to lay into the substrate. Progressively unroll the sheet while heating and insure a proper bond.
3. After the major portion of the roll is bonded, re-roll the first 6 feet and bond it in a similar fashion.
4. Repeat this operation with subsequent rolls with side laps of 4 inches and end laps of 8 inches.

5. Give each lap a finishing touch by passing the torch along the joint and spreading the melted bitumen evenly with a rounded trowel to insure a smooth, tight seal.
6. Extend underlayment 2 inches beyond top edges of cants at wall and projection bases.
7. Install base flashing ply to all perimeter and projections details.

B. Laps: Accurately align roofing sheets, without stretching, and maintain uniform side and end laps. Stagger end laps. Completely bond and seal laps, leaving no voids.

1. Repair voids in laps and lapped seams not completely sealed.

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

3.4 SBS MODIFIED BITUMINOUS CAP SHEET MEMBRANE INSTALLATION

A. Install modified bituminous cap sheet according to roofing manufacturer's written instructions, starting at low point of roofing system. Extend roofing membrane sheets over and terminate beyond cants, installing as follows:

1. Lay out the roll in the course to be followed and unroll 6 feet.
2. Using a roofing torch, heat the surface of the coiled portion until the burn-off backer melts away. At this point, the material is hot enough to lay into the substrate. Progressively unroll the sheet while heating and insure a proper bond.
3. After the major portion of the roll is bonded, re-roll the first 6 feet and bond it in a similar fashion.
4. Repeat this operation with subsequent rolls with side laps of 4 inches and end laps of 8 inches.
5. Give each lap a finishing touch by passing the torch along the joint and spreading the melted bitumen evenly with a rounded trowel to insure a smooth, tight seal.
6. Immediately broadcast new granules into bleedout while hot bitumen is still at EVT. All loose granules to be removed at end of project.

3.5 BASE FLASHING AND STRIPPING INSTALLATION

A. Install base flashing over cant strips and other sloped and vertical surfaces, at roof edges, and at penetrations through roof, and secure to substrates according to roofing system manufacturer's written instructions. Minimum base-flashing height of 8 inches is required. Install modified bituminous roofing sheet and cap sheet according to roofing manufacturer's written instructions, starting at low point of roofing system. Extend roofing membrane sheets over and terminate beyond cants, installing as follows:

1. Seal all curb, wall and parapet flashings with an application of mastic and mesh on a daily basis. Do not permit conditions to exist that will allow moisture to enter behind, around or under the roof or flashing membrane.
2. Prepare all walls, penetrations, expansion joints [and where shown on the drawings] to be flashed with asphalt primer at the rate of one hundred (100) square feet per gallon. Allow primer to dry tack free.
3. Heat fuse entire base ply membrane until burn off paper is gone. Fully adhere membrane to the underlying substrate.
4. After the laps have been tested and complete positive bond has been achieved, the applicator shall heat the seam edge and trowel along the seam edge. Troweling shall continue until a sloped, beveled edge has been produced.
5. Heat fuse finished membrane in the same manner as base ply. Seal all vertical laps of flashing membrane with a three-course application of trowel-grade mastic and fiberglass mesh. Install termination bar at top of assembly and seal with a three-course application of trowel-grade mastic and fiberglass mesh.

6. Terminate all base flashings using extruded aluminum termination bar. Three-course all terminations with PVC Mesh and specified mastic.

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

3.6 REFLECTIVE ROOF COATING APPLICATION

A. Base Flashing roofing plies and mastics shall be allowed to cure for thirty (30) days prior to application of the coating system.

B. Prior to coating application, all existing non-embedded granule surfacing material shall be removed by means of a stiff bristle street broom, powered mechanical sweeper, or vacuuming. All loose dirt and dust remaining after granule removal must be broomed and/or vacuumed from the roof. All blisters, ridges and other imperfections must be secured so that the surface will be clean and dry and a secure base for coating application.

1. The first coat of the Base Coat shall be applied the same day as the surface is cleaned. In no case shall the coating be applied over a dirty surface.
2. The coating system shall be roller applied in a cross hatch technique without causing runs or puddles.
3. The coating system shall be evenly applied in at least 2 separate coats to achieve a minimum system of 22-32 mils dry film thickness. Allow thorough dry time between coats.
4. No coating shall be applied if weather will not allow it to dry prior to exposure to precipitation or freezing temperatures.

3.7 ROOF DETAIL APPLICATION

A. Coordinate counter flashing, cap flashings, expansion joints, and similar work with modified bitumen roofing work (as specified in other Sections).

B. Coordinate roof accessories, miscellaneous sheet metal accessory items, including piping vents and other devices with the roofing system work (as specified in other Sections).

C. Curb Detail:

1. Minimum curb height is eight (8) inches. Prime vertically at a rate of one hundred (100) square feet per gallon and allow to dry.
2. Set cant in bitumen. Run all field plies over cant a minimum of two (2) inches.
3. Install base flashing assembly.
4. Install pre-manufactured counter-flashing with fasteners and neoprene washers or per manufacturer's recommendations.

D. Flanged Penetration Detail:

1. Minimum stack height is twelve (12) inches.
2. Run roof system over the entire surface of the roof. Seal the base of the stack with elastomeric sealant.
3. Prime both surfaces of flange of new sleeve. Install properly sized sleeves set in (¼) inch bed of roof cement.
4. Install stripping ply prior to cap sheet installation.

3.8 FIELD QUALITY CONTROL

A. Perform manufacturer’s field inspection and as required a minimum of three (3) days per week.

B. Correct defects or irregularities discovered during field inspection.

C. Require attendance of roofing materials manufacturers' representatives at site during installation of the roofing system. A copy of the specification should also be on site at all times.

3.9 PROTECTING AND CLEANING

A. Protect roofing system from damage and wear during remainder of construction period. When remaining construction does not affect or endanger roofing, inspect roofing for deterioration and damage, describing its nature and extent in a written report, with copies to Architect and Owner.

B. Correct deficiencies in or remove roofing system that does not comply with requirements, repair substrates, and repair or reinstall roofing system to a condition free of damage and deterioration at time of Substantial Completion and according to warranty requirements.

C. Remove bitumen adhesive drippings from all walls, windows, floors, ladders and finished surfaces.

D. In areas where finished surfaces are soiled by asphalt or any other sources of soiling caused by work of this Section, consult manufacturer of surfaces for cleaning instructions and conform to their instructions.

E. Repair or replace defaced or disfigured finishes caused by work of this Section.

3.10 CONSTRUCTION WASTE MANAGEMENT

A. Remove and properly dispose of waste products generated during roofing procedures. Comply with requirements of authorities having jurisdiction.

3.11 FINAL INSPECTION

A. At completion of roofing installation and associated work, meet with Contractor, Architect, installer, installer of associated work, Owner, roofing system manufacturer's representative, and other representatives directly concerned with performance of roofing system.

B. Walk roof surface areas of the building, inspect perimeter building edges as well as flashing of roof penetrations, walls, curbs and other equipment. List all items requiring correction or completion and furnish copy of list to each party in attendance.

C. The roofing system manufacturer reserves the right to request a thermographic scan of the roof during final inspection to determine if any damp or wet materials have been installed. The thermographic scan shall be provided by the Roofing Contractor.

D. If core cuts verify the presence of damp or wet materials, the Roofing Contractor shall be required to replace the damaged areas at his own expense.

E. Repair or replace deteriorated or defective work found at time above inspection as required to a produce an installation which is free of damage and deterioration at time of Substantial Completion and according to warranty requirements.

F. Notify the Owner and Architect upon completion of corrections.

G. Following the final inspection, provide written notice of acceptance of the installation from the roofing system manufacturer.

H. Immediately correct roof leakage during construction. If the Contractor does not respond within twenty four (24) hours, the Owner will exercise rights to correct the Work under the terms of the Conditions of the Contract.

END OF SECTION 075216

SECTION 076200 - SHEET METAL FLASHING AND TRIM

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Formed Products:
   a. Formed copings and parapet caps.
   b. Formed roof drainage sheet metal fabrications.
   c. Formed low-slope roof sheet metal fabrications.
   d. Formed wall sheet metal fabrications.
   e. Formed overhead-piping safety pans.

B. Related Sections:

1. Section 042100 “Architectural Unit Masonry” for sheet metal flashing integral with masonry cavity wall construction.
2. Section 072726 “Air Barriers” for integration with air barrier materials.
3. Section 075200 "Modified Bitumen Membrane Roofing" for sheet metal flashing integral with membrane roofing.
4. Section 133419 "Metal Building Systems" for sheet metal flashing integral with metal roof and wall systems.

1.2 PERFORMANCE REQUIREMENTS

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

B. Comply with NRCA Roofing Manual” (current edition) and SMACNA’s Architectural Sheet Metal Manual requirements for dimensions and profiles unless more stringent requirements are indicated.

C. Fabricate and install perimeter edge flashing and test in accordance with ANSI/SPRI ES-1 Wind Design Standard. Flashing shall be designed to resist design pressures indicated on Drawings.

D. Thermal Movements: Provide sheet metal flashing and trim that allows for thermal movements from ambient and surface temperature changes.

1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each manufactured product and accessory. Include product test reports for each product performed by a qualified testing agency.

B. Shop Drawings: Show fabrication and installation layouts of sheet metal flashing and trim, including plans, elevations, expansion-joint locations, and keyed details specific to the Project. Distinguish between shop- and field-assembled work. Include the following, at a minimum:

1. Identification of material, thickness, weight, and finish for each item and location in Project.
2. Details for forming sheet metal flashing and trim, including profiles, shapes, seams, and dimensions.
3. Details for joining, supporting, and securing sheet metal flashing and trim, including layout of fasteners, cleats, clips, and other attachments. Include pattern of seams.
4. Details of termination points and assemblies, including fixed points.
5. Details of expansion joints and expansion-joint covers, including showing direction of expansion and contraction.
6. Details of edge conditions, including eaves, ridges, valleys, rakes, crickets, and counterflashings as applicable.
7. Details of special conditions.
8. Details of connections to adjoining work.
9. Detail formed flashing and trim at a scale of not less than 3 inches per 12 inches.

C. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below:

1. Sheet Metal Flashing: 12 inches long by actual width of unit, including finished seam and in required profile. Include fasteners, cleats, clips, closures, and other attachments.

D. Qualification Data: For qualified fabricator.

E. Maintenance Data: For sheet metal flashing, trim, and accessories to include in maintenance manuals.

F. Warranty: Sample of special warranty.

1.4 QUALITY ASSURANCE

A. Fabricator Qualifications: Shop that employs skilled workers who custom fabricate sheet metal flashing and trim similar to that required for this Project and whose products have a record of successful in-service performance. Fabricator shall be ANSI/SPRI ES-1 certified for the profiles anticipated for use on the Project.

B. Sheet Metal Flashing and Trim Standard: Comply with SMACNA's "Architectural Sheet Metal Manual" unless more stringent requirements are specified or shown on Drawings.

C. Mockups: Supply metal flashings required for comprehensive mockups specified in other sections.

1. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.

D. Preinstallation Conference: Conduct conference at Project site.

1. Meet with Owner, Architect, Owner's insurer if applicable, Installer, and installers whose work interfaces with or affects sheet metal flashing and trim including installers of roofing materials, roof accessories, unit skylights, and roof-mounted equipment.
2. Review methods and procedures related to sheet metal flashing and trim.

3. Examine substrate conditions for compliance with requirements, including flatness and attachment to structural members.
4. Review special roof details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that will affect sheet metal flashing.
5. Document proceedings, including corrective measures and actions required, and furnish copy of record to each participant.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Do not store sheet metal flashing and trim materials in contact with other materials that might cause staining, denting, or other surface damage. Store sheet metal flashing and trim materials away from uncured concrete and masonry.

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

1.6 WARRANTY

A. Special Warranty on Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace sheet metal flashing and trim that shows evidence of deterioration of factory-applied finishes within specified warranty period.

1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:
   a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
   b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
   c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

2. Finish Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SHEET METALS

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

B. Metallic-Coated Steel Sheet (Prefinished Steel): Provide zinc-coated (galvanized) steel sheet according to ASTM A 653/A 653M, G90 coating designation or aluminum-zinc alloy-coated steel sheet according to ASTM A 792/A 792M, Class AZ50 coating designation, Grade 40; prepainted by coil-coating process to comply with ASTM A 755/A 755M.

1. Surface: Smooth, flat.
2. Exposed Coil-Coated Finish:
   a. Two-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

3. Color: As selected by Architect from manufacturer's full range.
4. Concealed Finish: Pretreat with manufacturer's standard white or light-colored acrylic or polyester backer finish, consisting of prime coat and wash coat with minimum total dry film thickness of 0.5 mil.

C. Stainless-Steel Sheet, Concealed or Thru-wall: ASTM A 240/A 240M or ASTM A 666, Type 304, dead soft, fully annealed; with smooth, flat surface.

1. Finish: 2D (dull, cold rolled).

2.2 UNDERLAYMENT MATERIALS

A. Self-Adhering, High-Temperature Sheet: As specified in Section 072726 “Air Barriers.”

2.3 MISCELLANEOUS MATERIALS

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

B. Fasteners: Wood screws, annular threaded nails, self-tapping screws, self-locking rivets and bolts, and other suitable fasteners designed to withstand design loads and recommended by manufacturer of primary sheet metal or manufactured item.

1. General: Blind fasteners or self-drilling screws, gasketed, with hex-washer head.
   a. Exposed Fasteners: Heads matching color of sheet metal using plastic caps or factory-applied coating.
   b. Blind Fasteners: High-strength aluminum or stainless-steel rivets suitable for metal being fastened.
2. Fasteners for Aluminum Sheet: Aluminum or Series 300 stainless steel.
3. Fasteners for Stainless-Steel Sheet: Series 300 stainless steel.
4. Hot-dip galvanized steel according to ASTM A 153/A 153M or ASTM F 2329 or Series 300 stainless steel.

C. Solder:

1. For Stainless Steel: ASTM B 32, Grade Sn60, with an acid flux of type recommended by stainless-steel sheet manufacturer.

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

E. Elastomeric Sealant: ASTM C 920, elastomeric silicone polymer sealant; low modulus; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight in accordance with Section 079200.

F. Butyl Sealant: For concealed joints only; ASTM C 1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for hooked-type expansion joints with limited movement.

G. Bituminous Coating: Cold-applied asphalt emulsion complying with ASTM D 1187.

H. Asphalt Roofing Cement: ASTM D 4586, asbestos free, of consistency required for application.

2.4 FABRICATION, GENERAL

A. General: Custom fabricate sheet metal flashing and trim to comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, geometry, metal thickness, and other characteristics of item indicated. Fabricate items at the shop to greatest extent possible.

1. Fabricate sheet metal flashing and trim in thickness or weight needed to comply with performance requirements, but not less than that specified for each application and metal.
2. Obtain field measurements for accurate fit before shop fabrication.
3. Form sheet metal flashing and trim without excessive oil canning, buckling, and tool marks and true to line and levels indicated, with exposed edges folded back to form hems.
4. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces exposed to view.

B. Listed thicknesses of metal shall be considered minimum. Actual thicknesses may vary based on performance requirements. Verify thicknesses prior to installation. Where possible, use manufacturer’s liquid flashing system.

C. Fabrication Tolerances: Fabricate sheet metal flashing and trim that is capable of installation to a tolerance of 1/4 inch in 20 feet on slope and location lines as indicated and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.

D. Sealed Joints: Form nonexpansion but movable joints in metal to accommodate elastomeric sealant.

E. Expansion Provisions: Where lapped expansion provisions cannot be used, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with butyl sealant concealed within joints.

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

G. Fabricate cleats and attachment devices of sizes as required as part of ANSI/SPRI ES-1 compliant assembly utilizing guidance provided within SMACNA's "Architectural Sheet Metal Manual" and by FMG Loss Prevention Data Sheet 1-49 for application, thickness shall be one size thicker than the thickness of metal being secured.

H. Seams: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with elastomeric sealant unless otherwise recommended by sealant manufacturer for intended use. Rivet joints where necessary for strength.

1. Seams for Stainless Steel: Fabricate nonmoving seams with flat-lock seams. Tin edges to be seamed, form seams, and solder.
2. Seams for Unpainted or Uncoated Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints where necessary for strength.

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

2.5 ROOF-DRAINAGE SHEET METAL FABRICATIONS

A. Downspouts: Fabricate rectangular downspouts to dimensions indicated, complete with mitered elbows. Furnish with metal hangers from same material as downspouts and anchors. Shop fabricate elbows.

1. Hanger Style: As detailed.
2. Fabricate from the following materials:
   a. Prefinished Steel: 0.028 inch (24 gage) thick.

B. Scuppers: Fabricate scuppers to dimensions required, with closure flange trim to exterior, 4-inch-wide wall flanges to interior, and base extending 4 inches beyond cant or tapered strip into field of roof. Fabricate from the following materials:

1. Stainless Steel: 0.025 inch (24 gage) thick.

C. Conductor Heads: Fabricate conductor heads with flanged back and stiffened top edge and of dimensions and shape indicated, complete with outlet tubes, exterior flange trim, and built-in overflows.

1. Fabricate from 0.028 inch (24 gage) prefinished steel sheet.

2.6 LOW-SLOPE ROOF SHEET METAL FABRICATIONS

A. Copings and Parapet Caps: Fabricate from the following materials:

1. Prefinished Steel: 0.034 inch (22 gage) thick.

B. Counterflashing: Shop fabricate interior and exterior corners. Fabricate from the following materials:

1. Stainless Steel: 0.025 inch thick (24 gage), unless otherwise indicated.

C. Flashing Receivers: Fabricate from the following materials:

1. Stainless Steel: 0.025 inch thick (24 gage), unless otherwise indicated.

D. Roof-Penetration Flashing: Fabricate from the following materials:

1. Liquid flashing system specified in Section 075200 "Modified Bitumen Membrane Roofing."

E. Roof-Drain Flashing: Fabricate from the following materials:

1. Lead Sheet: 4 lbs/sf, unless otherwise indicated.

F. Equipment Support Flashing: Fabricate from the following materials:

1. Stainless Steel: 0.025 inch (24 gage) thick.

2.7 WALL SHEET METAL FABRICATIONS

A. Through-Wall Flashing: Fabricate continuous flashings in minimum 96-inch-long, but not exceeding 12-foot-long, sections, under masonry copings, and at shelf angles. Fabricate discontinuous lintel, sill, and similar flashings to extend 6 inches beyond each side of wall openings; and form with 2-inch-high, end dams. Fabricate from the following materials:

1. Stainless Steel: 0.025 inch (24 gage) thick.

B. Angle Flashings around Openings in Veneer Masonry Construction: Fabricate continuous angles sized to match the cavity depth around openings in veneer masonry construction. Within size limitations of materials, use a single piece for each side of opening.

1. Aluminum: 0.040 inch thick.

2.8 MISCELLANEOUS SHEET METAL FABRICATIONS

A. Overhead-Piping Safety Pans: Fabricate from the following materials:

1. Galvanized Steel: 0.040 (20 gage) inch thick.
2. Aluminum-Zinc Alloy-Coated Steel: 0.040 inch (20 gage) thick.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, to verify actual locations, dimensions and other conditions affecting performance of the Work.

1. Verify compliance with requirements for installation tolerances of substrates.
2. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.

B. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

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

3.2 UNDERLAYMENT INSTALLATION

A. General: Install underlayment as indicated on Drawings.

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

3.3 INSTALLATION, GENERAL

A. General: Anchor sheet metal flashing and trim and other components of the Work securely in place, with provisions for thermal and structural movement. Use fasteners, solder, welding rods, protective coatings, separators, sealants, and other miscellaneous items as required to complete sheet metal flashing and trim system.

1. Install sheet metal flashing and trim true to line and levels indicated. Provide uniform, neat seams with minimum exposure of solder, welds, and sealant.
2. Install sheet metal flashing and trim to fit substrates and to result in watertight performance. Verify shapes and dimensions of surfaces to be covered before fabricating sheet metal.

3. Install cleats continuously for perimeter edge flashing. Anchor each section with fasteners not more than 12 inches apart. Anchor each cleat with two fasteners. Bend tabs over fasteners.
4. Install exposed sheet metal flashing and trim without excessive oil canning, buckling, and tool marks.
5. Install sealant tape where indicated.
6. Torch cutting of sheet metal flashing and trim is not permitted.
7. Do not use graphite pencils to mark metal surfaces.

B. Metal Protection: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with bituminous coating or by other permanent separation as recommended by SMACNA.

1. Coat back side of uncoated aluminum and stainless-steel sheet metal flashing and trim with bituminous coating where flashing and trim will contact wood, ferrous metal, or cementitious construction.

C. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet with no joints allowed within 24 inches of corner or intersection. Where lapped expansion provisions cannot be used or would not be sufficiently watertight, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with sealant concealed within joints.

D. Fastener Sizes: Use fasteners of sizes not less than recommended by fastener manufacturer to achieve maximum pull-out resistance.

E. Seal joints as shown and as required for watertight construction.

1. Where sealant-filled joints are used, embed hooked flanges of joint members not less than 1 inch into sealant. Form joints to completely conceal sealant. When ambient temperature at time of installation is moderate, between 40 and 70 deg F, set joint members for 50 percent movement each way. Adjust setting proportionately for installation at higher ambient temperatures. Do not install sealant-type joints at temperatures below 40 deg F.
2. Prepare joints and apply sealants to comply with requirements in Division 07 Section "Joint Sealants."

F. Soldered Joints: Clean surfaces to be soldered, removing oils and foreign matter. Pre-tin edges of sheets to be soldered to a width of 1-1/2 inches, except reduce pre-tinning where pre-tinned surface would show in completed Work. Surfaces to be soldered include but are not limited to external corners, elevation offsets, and custom flashing, such as saddles.

1. Do not solder aluminum sheet.
2. Pre-tinning is not required for zinc-tin alloy-coated stainless steel.
3. Do not use torches for soldering. Heat surfaces to receive solder and flow solder into joint. Fill joint completely. Completely remove flux and spatter from exposed surfaces.
4. Stainless-Steel Soldering: Tin edges of uncoated sheets using solder recommended for stainless steel and acid flux. Promptly remove acid flux residue from metal after tinning and soldering. Comply with solder manufacturer's recommended methods for cleaning and neutralization.

G. Rivets: Rivets not permitted for final attachment. Rivets allowed for temporary fastening of metal flashing during soldering.

3.4 ROOF FLASHING INSTALLATION

A. General: Install sheet metal flashing and trim to comply with performance requirements, sheet metal manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, set units true to line, and level as indicated. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.

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

C. Counterflashing: Coordinate installation of counterflashing with installation of base flashing. Insert counterflashing in reglets or receivers and fit tightly to base flashing. Extend counterflashing 4 inches over base flashing. Lap counterflashing joints a minimum of 4 inches and bed with sealant. Secure in a waterproof manner by means of snap-in installation and sealant or lead wedges and sealant.

D. Roof-Penetration Flashing:

1. Install liquid flashing system at penetrations through modified bitumen roofs in accordance with roof membrane manufacturer's instructions.

3.5 WALL FLASHING INSTALLATION

A. General: Install sheet metal wall flashing to intercept and exclude penetrating moisture according to SMACNA recommendations and as indicated. Coordinate installation of wall flashing with installation of wall-opening components such as windows, doors, and louvers.

B. Through-Wall Flashing: Coordinate installation of through-wall flashing with Section 042100" Architectural Unit Masonry.”

C. Opening Flashings in Frame Construction: Install continuous head, sill, and other similar flashings to extend a minimum of 8 inches beyond wall openings, unless otherwise indicated.

3.6 MISCELLANEOUS FLASHING INSTALLATION

A. Overhead-Piping Safety Pans: Suspend pans independent from structure above as indicated on Drawings. Pipe and install drain line to plumbing waste or drainage system.

3.7 ERECTION TOLERANCES

A. Installation Tolerances: Shim and align sheet metal flashing and trim within installed tolerance of 1/4 inch in 20 feet on slope and location lines as indicated and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.

3.8 CLEANING AND PROTECTION

A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.

B. Clean and neutralize flux materials. Clean off excess solder.

C. Clean off excess sealants.

D. Remove temporary protective coverings and strippable films as sheet metal flashing and trim are installed unless otherwise indicated in manufacturer's written installation instructions. On completion of installation, remove unused materials and clean finished surfaces. Maintain in a clean condition during construction.

E. Replace sheet metal flashing and trim that have been damaged or that have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 076200

SECTION 077200 - ROOF ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Roof hatches.

1.2 PERFORMANCE REQUIREMENTS

A. General Performance: Roof accessories shall withstand exposure to weather and resist thermally induced movement without failure, rattling, leaking, or fastener disengagement due to defective manufacture, fabrication, installation, or other defects in construction.

1. Design Loads: Refer to Structural Drawings.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of roof accessory indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

B. Shop Drawings: For roof accessories. Include plans, elevations, keyed details, and attachments to other work. Indicate dimensions, loadings, and special conditions. Distinguish between plant- and field-assembled work.

C. Samples: For each exposed product and for each color and texture specified, prepared on Samples of size to adequately show color.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Roof plans, drawn to scale, and coordinating penetrations and roof-mounted items. Show the following:

1. Size and location of roof accessories specified in this Section.
2. Method of attaching roof accessories to roof or building structure.
3. Other roof-mounted items including mechanical and electrical equipment, ductwork, piping, and conduit.
4. Required clearances.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For roof accessories to include in operation and maintenance manuals.

1.6 COORDINATION

A. Coordinate layout and installation of roof accessories with roofing membrane and base flashing and interfacing and adjoining construction to provide a leakproof, weathertight, secure, and noncorrosive installation.

B. Coordinate dimensions with rough-in information or Shop Drawings of equipment to be supported.

PART 2 - PRODUCTS

2.1 METAL MATERIALS

A. Aluminum Sheet: ASTM B 209, manufacturer's standard alloy for finish required, with temper to suit forming operations and performance required.

1. Mill Finish: As manufactured.

B. Aluminum Extrusions and Tubes: ASTM B 221, manufacturer's standard alloy and temper for type of use, finished to match assembly where used, otherwise mill finished.

C. Steel Tube: ASTM A 500, round tube.

2.2 MISCELLANEOUS MATERIALS

A. General: Provide materials and types of fasteners, protective coatings, sealants, and other miscellaneous items required by manufacturer for a complete installation.

B. Glass-Fiber Board Insulation: ASTM C726, nominal density of 3 lb/cu. ft., thermal resistivity of 4.3 deg F x h x sq. ft./Btu x in. at 75 deg F, thickness as indicated.

C. Wood Nailers: Softwood lumber, preservative treated in accordance with Section 061000; not less than 1-1/2 inches thick.

D. Underlayment: ASTM D 226, Type II (No. 30), asphalt-saturated organic felt, nonperforated.

E. Fasteners: Roof accessory manufacturer's recommended fasteners suitable for application and metals being fastened. Match finish of exposed fasteners with finish of material being fastened. Provide nonremovable fastener heads to exterior exposed fasteners. Furnish the following unless otherwise indicated:

1. Fasteners for Zinc-Coated or Aluminum-Zinc Alloy-Coated Steel: Series 300 stainless steel or hot-dip zinc-coated steel according to ASTM A 153/A 153M or ASTM F 2329.
2. Fasteners for Aluminum Sheet: Aluminum or Series 300 stainless steel.

F. Elastomeric Sealant: ASTM C 920, elastomeric silicone polymer sealant as recommended by roof accessory manufacturer for installation indicated; low modulus; of type, grade, class, and use classifications required to seal joints and remain watertight.

G. Butyl Sealant: ASTM C 1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for expansion joints with limited movement.

H. Asphalt Roofing Cement: ASTM D 4586, asbestos free, of consistency required for application.

2.3 ROOF HATCHES, MANUAL OPERATION

A. Manufacturers - Roof Hatches:

1. Bilco Co.: www.bilco.com
2. Dur-Red Products: www.dur-red.com.
3. Milcor Inc: www.milcorinc.com.
4. Substitutions: See Section 012500 - Substitution Procedures.

B. Roof Hatches: Factory-assembled aluminum frame and cover, complete with operating and release hardware.

1. Style: Provide flat metal covers unless otherwise indicated.
2. Mounting: Provide frames and curbs suitable for mounting on flat roof deck.
3. Size(s): 36 x 36 inches, single-leaf style.

C. Frames/Curbs: One-piece curb and frame with integral cap flashing to receive roof flashings; extended bottom flange to suit mounting.

1. Material: Mill finished aluminum, 11 gage, 0.125 inch thick.
2. Insulation: 1 inch rigid glass fiber, located on outside face of curb.
3. Curb Height: 12 inches from finished surface of roof, minimum.

D. Metal Covers: Flush, insulated, hollow metal construction.

1. Capable of supporting 40 psf live load.
2. Material: Mill finished aluminum; outer cover 0.125 inch thick, liner 0.04 inch thick.
3. Insulation: 1 inch rigid glass fiber.
4. Gasket: Neoprene, continuous around cover perimeter.

E. Hardware: Type 304 stainless steel, unless otherwise indicated or required by manufacturer.

1. Lifting Mechanisms: Compression or torsion spring operator with shock absorbers that automatically opens upon release of latch; capable of lifting covers despite 10 psf load.
2. Hinges: Heavy duty pintle type.
3. Hold open arm with vinyl-coated handle for manual release.
4. Latch: Upon closing, engage latch automatically and reset manual release.
5. Manual Release: Pull handle on interior.
6. Locking: Padlock hasp on interior.

F. Ladder-Assist Post: Roof-hatch manufacturer's standard device for attachment to roof-access ladder.

1. Operation: Post locks in place on full extension; release mechanism returns post to closed position.
2. Height: 42 inches above finished roof deck.
3. Material: Aluminum.
4. Post: 1-5/8-inch- diameter pipe.
5. Finish: Manufacturer's standard baked enamel or powder coat.
   a. Color: As selected by Architect from manufacturer's full range.

2.4 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, to verify actual locations, dimensions, and other conditions affecting performance of the Work.

B. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.

C. Verify dimensions of roof openings for roof accessories.

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

3.2 INSTALLATION

A. General: Install roof accessories according to manufacturer's written instructions.

1. Install roof accessories level, plumb, true to line and elevation, and without warping, jogs in alignment, excessive oil canning, buckling, or tool marks.
2. Anchor roof accessories securely in place so they are capable of resisting indicated loads.
3. Use fasteners, separators, sealants, and other miscellaneous items as required to complete installation of roof accessories and fit them to substrates.
4. Install roof accessories to resist exposure to weather without failing, rattling, leaking, or loosening of fasteners and seals.

B. Metal Protection: Protect metals against galvanic action by separating dissimilar metals from contact with each other or with corrosive substrates by painting contact surfaces with bituminous coating or by other permanent separation as recommended by manufacturer.

1. Underlayment: Where installing roof accessories directly on cementitious, ferrous metal, or wood substrates, install a course of felt underlayment and cover with manufacturer's recommended slip sheet.
2. Bed flanges in thick coat of asphalt roofing cement where required by manufacturers of roof accessories for waterproof performance.

C. Seal joints with elastomeric or butyl sealant as required by roof accessory manufacturer.

3.3 REPAIR AND CLEANING

A. Clean exposed surfaces according to manufacturer's written instructions.

B. Clean off excess sealants.

C. Replace roof accessories that have been damaged or that cannot be successfully repaired by finish touchup or similar minor repair procedures.

END OF SECTION

SECTION 079200 - JOINT SEALANTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Silicone joint sealants.
2. Latex joint sealants.
3. Butyl joint sealants.
4. Acoustical joint sealants.

B. Related Sections:

1. Section 078413 “Penetration Firestopping” for sealing joints in fire- and smoke-rated construction
2. Section 088000 "Glazing" for glazing sealants.
3. Section 092900 "Gypsum Board" for sealing perimeter joints in acoustically-rated walls.
4. Section 093000 "Tiling" for sealing tile joints.
5. Section 095113 "Acoustical Panel Ceilings" for sealing edge moldings at perimeters with acoustical sealant.

1.2 PRECONSTRUCTION TESTING

A. Preconstruction Compatibility and Adhesion Testing: Submit to joint-sealant manufacturers, for testing indicated below, samples of materials that will contact or affect joint sealants.

1. Use ASTM C 1087 to determine whether priming and other specific joint preparation techniques are required to obtain rapid, optimum adhesion of joint sealants to joint substrates.
2. Submit not fewer than eight pieces of each kind of material, including joint substrates, shims, joint-sealant backings, secondary seals, and miscellaneous materials.
3. Schedule sufficient time for testing and analyzing results to prevent delaying the Work.
4. For materials failing tests, obtain joint-sealant manufacturer's written instructions for corrective measures including use of specially formulated primers.
5. Testing will not be required if joint-sealant manufacturers submit joint preparation data that are based on previous testing, not older than 24 months, of sealant products for adhesion to, and compatibility with, joint substrates and other materials matching those submitted.

B. Preconstruction Field-Adhesion Testing: Before installing sealants, field test their adhesion to Project joint substrates as follows:

1. Locate test joints where indicated on Project or, if not indicated, as directed by Architect.
2. Conduct field tests for each application indicated below:
   a. Each kind of sealant and joint substrate indicated, using manufacturer’s recommended primers.
3. Notify Architect seven days in advance of dates and times when test joints will be erected.
4. Arrange for tests to take place with joint-sealant manufacturer's technical representative present.

a. Test Method: Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1 in ASTM C 1193 or Method A, Tail Procedure, in ASTM C 1521.
   1) For joints with dissimilar substrates, verify adhesion to each substrate separately; extend cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.

5. Report whether sealant failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each kind of product and joint substrate. For sealants that fail adhesively, retest until satisfactory adhesion is obtained.
6. Evaluation of Preconstruction Field-Adhesion-Test Results: Sealants not evidencing adhesive failure from testing, in absence of other indications of noncompliance with requirements, will be considered satisfactory. Do not use sealants that fail to adhere to joint substrates during testing.

1.3 ACTION SUBMITTALS

A. Product Data: For each joint-sealant product indicated.

B. Samples for Initial Selection: Manufacturer's color charts consisting of strips of cured sealants showing the full range of colors available for each product exposed to view.

C. Samples for Verification: For each kind and color of joint sealant required, provide Samples with joint sealants in 1/2-inch- wide joints formed between two 6-inch- long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.

D. Joint-Sealant Schedule: Include the following information:

1. Joint-sealant application, joint location, and designation.
2. Joint-sealant manufacturer and product name.
3. Joint-sealant formulation.
4. Joint-sealant color.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer and testing agency.

B. Product Certificates: For each kind of joint sealant and accessory, from manufacturer stating that products contain no asbestos.

C. Sealant, Waterproofing, and Restoration Institute (SWRI) Validation Certificate: For each sealant specified to be validated by SWRI's Sealant Validation Program.

D. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, indicating that sealants comply with requirements.

E. Preconstruction Compatibility and Adhesion Test Reports: From sealant manufacturer, indicating the following:

1. Materials forming joint substrates and joint-sealant backings have been tested for compatibility and adhesion with joint sealants.
2. Interpretation of test results and written recommendations for primers and substrate preparation needed for adhesion.

F. Preconstruction Field-Adhesion Test Reports: Indicate which sealants and joint preparation methods resulted in optimum adhesion to joint substrates based on testing specified in "Preconstruction Testing" Article.

G. Field-Adhesion Test Reports: For each sealant application tested.

H. Warranties: Sample of special warranties.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project with minimum of five years documented experience.

B. Source Limitations: Obtain each kind of joint sealant from single source from single manufacturer.

C. Product Testing: Test joint sealants using a qualified testing agency.

1. Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1021 to conduct the testing indicated.
2. Test according to SWRI's Sealant Validation Program for compliance with requirements specified by reference to ASTM C 920 for adhesion and cohesion under cyclic movement, adhesion-in-peel, and indentation hardness.

D. Mockups: Install sealant in mockups of assemblies specified in other Sections that are indicated to receive joint sealants specified in this Section. Use materials and installation methods specified in this Section.

E. Preinstallation Conference: Conduct conference at Project site.

1.6 PROJECT CONDITIONS

A. Do not proceed with installation of joint sealants under the following conditions:

1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer or are below 40 deg F.
2. When joint substrates are wet.
3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
4. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

1.7 WARRANTY

A. Special Installer's Warranty: Manufacturer's standard form in which Installer agrees to repair or replace joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

B. Special Manufacturer's Warranty: Manufacturer's standard form in which joint-sealant manufacturer agrees to furnish joint sealants to repair or replace those that do not comply with performance and other requirements specified in this Section within specified warranty period.

1. Warranty Period: Two years from date of Substantial Completion.

C. Special warranties specified in this article exclude deterioration or failure of joint sealants from the following:

1. Movement of the structure caused by structural settlement or errors attributable to design or construction resulting in stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression.
2. Disintegration of joint substrates from natural causes exceeding design specifications.
3. Mechanical damage caused by individuals, tools, or other outside agents.
4. Changes in sealant appearance caused by accumulation of dirt or other atmospheric contaminants.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

A. Compatibility: Provide joint sealants, backings, 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.

B. Conform to ASTM C1193 requirements for materials and installation.

C. Liquid-Applied Joint Sealants: Comply with ASTM C 920 and other requirements indicated for each liquid-applied joint sealant specified, including those referencing ASTM C 920 classifications for type, grade, class, and uses related to exposure and joint substrates.

D. Stain-Test-Response Characteristics: Where sealants are specified to be nonstaining to porous substrates, provide products that have undergone testing according to ASTM C 1248 and have not stained porous joint substrates indicated for Project.

E. Suitability for Contact with Food: Where sealants are indicated for joints that will come in repeated contact with food, provide products that comply with 21 CFR 177.2600.

F. Colors of Exposed Joint Sealants: As selected by Architect from manufacturer's full range.

2.2 SILICONE JOINT SEALANTS

A. Single-Component, Traffic Grade, Neutral-Curing Silicone Joint Sealant: ASTM C 920, Type S, Grade NS, Class 100/50, for Use T, NT.

1. Joint Locations:
   a. Exterior joints in and between masonry, concrete, and plaster surfaces.
   b. Exterior control joints in brick and stone pavers.

2. Basis-of-Design Product: Dow Chemical Company; Dowsil 790
   a. Color: As selected by Architect from manufacturer's full range of colors.

B. Single-Component, Nonsag, Neutral-Curing Silicone Joint Sealant: ASTM C 920, Type S, Grade NS, Class 50, for Use NT.

1. Joint Locations:
   a. Exterior exposed metal-to-metal joints.
   b. Perimeter joints of metal door and window frames on exterior side of exterior walls.

c. Perimeter joints of metal door and window frames on interior side of exterior walls.
d. Joints between countertops or backsplashes and interior side of exterior walls.
e. Other joints on interior side of exterior walls for which no other sealant is indicated.

2. Basis-of-Design Product: Dow Chemical Company; Dowsil 795
   a. Color: As selected by Architect from manufacturer's full range of colors.

C. Single-Component, Neutral-Curing Silicone Joint Sealant: ASTM C 920, Type S, Grade NS, Class 25, for Use NT.

1. Joint Locations:
   a. Concealed joints contacting air barrier membrane or flashing.

2. Basis-of-Design Product: Dow Chemical Company; Dowsil 758 Silicone Weather Barrier Sealant.
   a. Color: As selected by Architect from manufacturer's full range of colors.

D. Mildew-Resistant, Single-Component, Nonsag, Neutral-Curing Silicone Joint Sealant: ASTM C 920, Type S, Grade NS, Class 25, for Use NT.

1. Joint Locations:
   a. Interior joints between plumbing fixtures and adjoining walls, floors, and counters.
   b. Interior tile control and expansion joints in wet areas.
   c. Joints contacting epoxy-painted walls.

2. Basis-of-Design Product: Tremco Incorporated; Tremsil 200.
   a. Color: White.

2.3 LATEX JOINT SEALANTS

A. Latex Joint Sealant: Acrylic latex or siliconized acrylic latex: ASTM C 834, Type OP, Grade NF.

1. Joint Locations:
   a. Interior wall and ceiling control joints.
   b. Perimeter joints between interior wall surfaces and frames of interior doors and windows.
   c. Other interior joints for which no other sealant is indicated.

2. Basis-of-Design Product: Tremco Incorporated, Tremflex 834.
   a. Color: As selected by Architect from manufacturer's full range of colors.

2.4 BUTYL JOINT SEALANTS

A. Butyl-Rubber-Based Joint Sealants: ASTM C 1311.

1. Joint Locations:
   a. Concealed metal-to-metal joints.

2. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   a. Sika Corp
   b. Pecora Corporation

2.5 ACOUSTICAL JOINT SEALANTS

A. Acoustical Joint Sealant: Manufacturer's standard nonsag, paintable, nonstaining latex sealant complying with ASTM C 919. Product effectively reduces airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.

1. Joint Locations:
   a. Acoustical joints at tops and bottoms of non-fire-rated interior walls.

2. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   a. Pecora Corporation, BA-98 Non-Skinning Butyl Sealant.
   b. USG Corporation, USG Sheetrock Acoustical Sealant.

2.6 JOINT SEALANT BACKING

A. General: Provide sealant backings of material that are nonstaining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.

B. Cylindrical Sealant Backings: ASTM C 1330, Type C (closed-cell material with a surface skin) or any of the preceding types, as approved in writing by joint-sealant manufacturer for joint application indicated, and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.

1. Furnish open-cell or bi-cellular material where required within dual joint seals to permit proper curing of sealant.

C. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint. Provide self-adhesive tape where applicable.

2.7 MISCELLANEOUS MATERIALS

A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.

B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.

C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint-sealant performance.

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

3.2 PREPARATION

A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions and the following requirements:

1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.
2. Clean porous joint substrate surfaces by brushing, grinding, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air. Porous joint substrates include the following:
   a. Concrete.
   b. Masonry.
   c. Unglazed surfaces of ceramic tile.
   d. Exterior insulation and finish systems.
3. Remove laitance and form-release agents from concrete.
4. Clean nonporous joint substrate surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants. Nonporous joint substrates include the following:
   a. Metal.
   b. Glass.
   c. Porcelain enamel.
   d. Glazed surfaces of ceramic tile.

B. Joint Priming: Prime joint substrates where recommended by joint-sealant manufacturer or as indicated by preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.

C. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.3 INSTALLATION OF JOINT SEALANTS

A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.

B. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.

C. Install sealant backings of kind indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.

1. Do not leave gaps between ends of sealant backings.
2. Do not stretch, twist, puncture, or tear sealant backings.
3. Remove absorbent sealant backings that have become wet before sealant application and replace them with dry materials.

D. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.

E. Install sealants using proven techniques that comply with the following and at the same time backings are installed:

1. Place sealants so they directly contact and fully wet joint substrates.
2. Completely fill recesses in each joint configuration.
3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.
   a. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified in subparagraphs below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.
4. Remove excess sealant from surfaces adjacent to joints.
5. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
6. Provide concave joint profile per Figure 8A in ASTM C 1193, unless otherwise indicated.
7. Provide flush joint profile where indicated per Figure 8B in ASTM C 1193.
8. Provide recessed joint configuration of recess depth and at locations indicated per Figure 8C in ASTM C 1193.
   a. Use masking tape to protect surfaces adjacent to recessed tooled joints.

F. Acoustical Sealant Installation: At sound-rated assemblies and elsewhere as indicated, seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical sealant. Install acoustical sealant at both faces of partitions at perimeters and through penetrations. Comply with ASTM C 919 and with manufacturer's written recommendations.

3.4 FIELD QUALITY CONTROL

A. Field-Adhesion Testing: Field test joint-sealant adhesion to joint substrates as follows:

1. Extent of Testing: Test completed and cured sealant joints as follows:
   a. Perform 10 tests for the first 1000 feet of joint length for each kind of sealant and joint substrate.
   b. Perform 1 test for each 1000 feet of joint length thereafter or 1 test per each floor per elevation.
2. Test Method: Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1 in ASTM C 1193 or Method A, Tail Procedure, in ASTM C 1521.

a. For joints with dissimilar substrates, verify adhesion to each substrate separately; extend cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.

3. Inspect tested joints and report on the following:
   a. Whether sealants filled joint cavities and are free of voids.
   b. Whether sealant dimensions and configurations comply with specified requirements.
   c. Whether sealants in joints connected to pulled-out portion failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each kind of product and joint substrate. Compare these results to determine if adhesion passes sealant manufacturer's field-adhesion hand-pull test criteria.
4. Record test results in a field-adhesion-test log. Include dates when sealants were installed, names of persons who installed sealants, test dates, test locations, whether joints were primed, adhesion results and percent elongations, sealant fill, sealant configuration, and sealant dimensions.
5. Repair sealants pulled from test area by applying new sealants following same procedures used originally to seal joints. Ensure that original sealant surfaces are clean and that new sealant contacts original sealant.

B. Evaluation of Field-Adhesion Test Results: Sealants not evidencing adhesive failure from testing or noncompliance with other indicated requirements will be considered satisfactory. Remove sealants that fail to adhere to joint substrates during testing or to comply with other requirements. Retest failed applications until test results prove sealants comply with indicated requirements.

3.5 CLEANING

A. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

3.6 PROTECTION

A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original work.

END OF SECTION

SECTION 081113 - HOLLOW METAL DOORS AND FRAMES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes hollow-metal work.

B. Related Requirements:

1. Section 087100 "Door Hardware" for door hardware for hollow-metal doors.

1.2 DEFINITIONS

A. Minimum Thickness: Minimum thickness of base metal without coatings according to NAAMM-HMMA 803 or SDI A250.8.

1.3 COORDINATION

A. Coordinate anchorage installation for hollow-metal frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, core descriptions, fire-resistance ratings, temperature-rise ratings, and finishes.

B. Shop Drawings: Include the following:

1. Elevations of each door type.
2. Details of doors, including vertical- and horizontal-edge details and metal thicknesses.
3. Frame details for each frame type, including dimensioned profiles and metal thicknesses.
4. Locations of reinforcement and preparations for hardware.
5. Details of each different wall opening condition.
6. Details of anchorages, joints, field splices, and connections.
7. Details of accessories.
8. Details of moldings, removable stops, and glazing.
9. Details of conduit and preparations for power, signal, and control systems.

C. Schedule: Provide a schedule of hollow-metal work prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings. Coordinate with final Door Hardware Schedule.

1.6 INFORMATIONAL SUBMITTALS

A. Product Test Reports: For each type of hollow-metal door and frame assembly, for tests performed by a qualified testing agency.

B. Oversize Construction Certification: For assemblies required to be fire rated and exceeding limitations of labeled assemblies.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver hollow-metal work palletized, packaged, or crated to provide protection during transit and Project-site storage. Do not use nonvented plastic.

B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.

C. Store hollow-metal work vertically under cover at Project site with head up. Place on minimum 4-inch- high wood blocking. Provide minimum 1/4-inch space between each stacked door to permit air circulation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

1. Ceco Door Products; an Assa Abloy Group company.
2. Curries Company; an Assa Abloy Group company.
3. Pearland Industries.
4. Republic Doors and Frames.
5. Steelcraft; an Allegion company.

B. Source Limitations: Obtain hollow-metal work from single source from single manufacturer.

2.2 REGULATORY REQUIREMENTS

A. Fire-Rated Assemblies: Complying with NFPA 80 and listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction for fire-protection ratings and temperature-rise limits indicated, based on testing at positive pressure according to NFPA 252 or UL 10C.

1. Smoke- and Draft-Control Assemblies: Provide an assembly with gaskets listed and labeled for smoke and draft control by a qualified testing agency acceptable to authorities having jurisdiction, based on testing according to UL 1784 and installed in compliance with NFPA 105.

B. Fire-Rated, Borrowed-Light Assemblies: Complying with NFPA 80 and listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction for fire-protection ratings indicated, based on testing according to NFPA 257 or UL 9.

2.3 STANDARD HOLLOW METAL DOORS

A. General: Provide 1-3/4 inch doors of design indicated, not less than thickness indicated; fabricated with smooth surfaces, without visible joints or seams on exposed faces unless otherwise indicated. Comply with ANSI/SDI A250.8 and ANSI/NAAMM HMMA 867.

B. Exterior Doors: Face sheets fabricated of commercial quality hot-dipped zinc coated steel that complies with ASTM A924 A60. Provide doors complying with requirements indicated below by referencing ANSI/SDI A250.8 for level and model, ANSI/SDI A250.4 for physical performance level, and HMMA 867 for door construction.

1. Design: Flush panel.
2. Core Construction: Foamed in place polyurethane and steel stiffened laminated core with no stiffener face welds, in compliance with HMMA 867 "Laminated Core".
   a. Provide 22 gage steel stiffeners at 6 inches on-center internally welded at 5" on-center to integral core assembly, foamed in place polyurethane core chemically bonded to all interior surfaces. No stiffener face welding is permitted.
   b. Thermal-Rated (Insulated) Doors: Where indicated, provide doors fabricated with thermal-resistance calculated core values U-Factor 0.09, R-value 11.0 (ASTM C518) when tested according to ASTM C 1363.
3. Level/Model: Level 3 and Physical Performance Level A (Extra-Heavy Duty), Minimum 16 gage (0.053 inch) thick steel, Model 2.
4. Vertical Edges: Vertical edges to have the face sheets joined by a continuous weld extending the full height of the door. Welds are to be ground, filled and dressed smooth. Beveled Lock Edge, 1/8 inch in 2 inches
5. Top and Bottom Edges: Reinforce tops and bottoms of doors with a continuous steel channel not less than 16 gage, extending the full width of the door and welded to the face sheet. Doors with an inverted top channel to include a steel closure channel, screw attached, with the web of the channel flush with the face sheets of the door. Plastic or composite channel fillers are not acceptable.
6. Hinge Reinforcement: Minimum 7 gage (3/16") plate 1-1/4" x 9".
7. Hardware Reinforcements: Fabricate according to ANSI/SDI A250.6 with reinforcing plates from same material as door face sheets.

C. Interior Doors: Face sheets fabricated of commercial quality cold rolled steel that complies with ASTM A 1008/A 1008M. Provide doors complying with requirements indicated below by referencing ANSI/SDI A250.8 for level and model and ANSI/SDI A250.4 for physical performance level, and HMMA 867 for door construction.

1. Design: Flush panel.
2. Core Construction: Foamed in place polyurethane and steel stiffened laminated core with no stiffener face welds, in compliance with HMMA 867 "Laminated Core".
   a. Provide 22 gage steel stiffeners at 6 inches on-center internally welded at 5" on-center to integral core assembly, foamed in place polyurethane core chemically bonded to all interior surfaces. No stiffener face welding is permitted.
   b. Fire Door Core: As required to provide fire-protection and temperature-rise ratings indicated.
3. Level/Model: Level 2 and Physical Performance Level A (Heavy Duty), minimum 18 gage (0.042-inch - 1.0-mm) thick steel, Model 2.
4. Vertical Edges: Vertical edges to have the face sheets joined by a continuous weld extending the full height of the door. Welds are to be ground, filled and dressed smooth. Beveled Lock Edge, 1/8 inch in 2 inches.

5. Top and Bottom Edges: Reinforce tops and bottoms of doors with a continuous steel channel not less than 16 gage, extending the full width of the door and welded to the face sheet. Doors with an inverted top channel to include a steel closure channel, screw attached, with the web of the channel flush with the face sheets of the door. Plastic or composite channel fillers are not acceptable.
6. Hinge Reinforcement: Minimum 7 gage (3/16") plate 1-1/4" x 9" or minimum 14 gage continuous channel with pierced holes, drilled and tapped.
7. Hardware Reinforcements: Fabricate according to ANSI/SDI A250.6 with reinforcing plates from same material as door face sheets.

2.4 STANDARD HOLLOW METAL FRAMES

A. General: Comply with ANSI/SDI A250.8 and with details indicated for type and profile.

B. Exterior Frames: Fabricated of hot-dipped zinc coated steel that complies with ASTM A 653/A 653M, Coating Designation A60.

1. Fabricate frames with mitered or coped corners.
2. Fabricate frames with full profile welded joints.
3. Frames for Steel Doors: Minimum 16 gage (0.053-inch) - thick steel sheet.

C. Interior Frames: Fabricated from cold-rolled steel sheet that complies with ASTM A 1008/A 1008M.

1. Fabricate frames with mitered or coped corners.
2. Fabricate frames with full profile welded joints.
3. Frames for Steel Doors: Minimum 16 gage (0.053-inch)- thick steel sheet.
4. Frames for Wood Doors: Minimum 16 gage (0.053-inch)- thick steel sheet.
5. Frames for Borrowed Lights: Minimum 16 gage (0.053-inch)- thick steel sheet.

D. Fire rated frames: Fabricate frames in accordance with NFPA 80, listed and labeled by a qualified testing agency, for fire-protection ratings indicated.

E. Hardware Reinforcement: Fabricate according to ANSI/SDI A250.6 Table 4 with reinforcement plates from same material as frames.

2.5 FRAME ANCHORS

A. Jamb Anchors:

1. Masonry Type: Adjustable strap-and-stirrup or T-shaped anchors to suit frame size, not less than 0.042 inch thick, with corrugated or perforated straps not less than 2 inches wide by 10 inches long; or wire anchors not less than 0.177 inch thick.
2. Stud-Wall Type: Designed to engage stud, welded to back of frames; not less than 0.042 inch thick.
3. Compression Type for Drywall Slip-on Frames: Adjustable compression anchors.
4. Postinstalled Expansion Type for In-Place Concrete or Masonry: Minimum 3/8-inch-diameter bolts with expansion shields or inserts. Provide pipe spacer from frame to wall, with throat reinforcement plate, welded to frame at each anchor location.

B. Floor Anchors: Formed from same material as frames, minimum thickness of 0.042 inch, and as follows:

1. Monolithic Concrete Slabs: Clip-type anchors, with two holes to receive fasteners.

2. Separate Topping Concrete Slabs: Adjustable-type anchors with extension clips, allowing not less than 2-inch height adjustment. Terminate bottom of frames at finish floor surface.

2.6 MATERIALS

A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B; suitable for exposed applications.

B. Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.

C. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B.

D. Frame Anchors: ASTM A 879/A 879M, Commercial Steel (CS), 04Z coating designation; mill phosphatized.

1. For anchors built into exterior walls, steel sheet complying with ASTM A 1008/A 1008M or ASTM A 1011/A 1011M, hot-dip galvanized according to ASTM A 153/A 153M, Class B.

E. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A 153/A 153M.

F. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hollow-metal frames of type indicated.

G. Grout: ASTM C 476, except with a maximum slump of 4 inches, as measured according to ASTM C 143/C 143M.

H. Mineral-Fiber Insulation: ASTM C 665, Type I (blankets without membrane facing); consisting of fibers manufactured from slag or rock wool; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively; passing ASTM E 136 for combustion characteristics.

I. Install glazing in accordance with requirements in Section 088000 "Glazing."

J. Bituminous Coating: Cold-applied asphalt mastic, compounded for 15-mil dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

2.7 FABRICATION

A. Fabricate hollow metal work to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for thickness of metal. Where practical, fit and assemble units in manufacturer's plant. When shipping limitations so dictate, frames for large openings are to be fabricated in sections for splicing or splining in the field by others.

B. Tolerances: Fabricate hollow metal work to tolerances indicated in ANSI/SDI A250.8.

C. Hollow Metal Doors:

1. Exterior Doors: Provide optional weep-hole openings in bottom of exterior doors to permit moisture to escape where specified.

2. Glazed Lites: Factory cut openings in doors with applied trim or kits to fit. Factory install glazing where indicated.
3. Astragals: Provide overlapping astragals as noted in door hardware sets in Division 08 Section "Door Hardware" on one leaf of pairs of doors where required by NFPA 80 for fire-performance rating or where indicated. Extend minimum 3/4 inch beyond edge of door on which astragal is mounted.
4. Continuous Hinge Reinforcement: Provide welded continuous 12 gage strap for continuous hinges specified in hardware sets in Division 08 Section "Door Hardware".
5. Electrical Raceways: Provide hollow metal doors to receive electrified hardware with concealed wiring harness and standardized Molex plug connectors on both ends to accommodate up to twelve wires. Coordinate connectors on end of the wiring harness to plug directly into the electrified hardware and the through-wire transfer hardware or wiring harness specified in hardware sets in Division 08 Sections "Door Hardware". Wire nut connections are not acceptable.

D. Hollow Metal Frames: Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of same thickness metal as frames.

1. Welded Frames: Weld flush face joints continuously; grind, fill, dress, and make smooth, flush, and invisible. Continuously back weld joints at exterior frames.
   a. Welded frames are to be provided with two steel spreaders temporarily attached to the bottom of both jambs to serve as a brace during shipping and handling. Spreader bars are for bracing only and are not to be used to size the frame opening.
2. Sidelight and Transom Bar Frames: Provide closed tubular members with no visible face seams or joints, fabricated from same material as door frame. Fasten members at crossings and to jambs by butt welding.
3. High Frequency Hinge Reinforcement: Provide high frequency hinge reinforcements at door openings 48-inches and wider with mortise/butt type hinges at top hinge locations.
4. Continuous Hinge Reinforcement: Provide welded continuous 12 gage straps for continuous hinges specified in hardware sets in Division 08 Section "Door Hardware."
5. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated for removable stops, provide security screws at exterior locations.
6. Grout Guards: Weld guard boxes to frame at back of hardware mortises in frames at all hinges and strike preps regardless of grouting requirements.
7. Electrical Thru-Wiring: Provide hollow metal frames receiving electrified hardware with loose wiring harness (not attached to open throat components or installed in closed mullion tubes) and standardized Molex plug connectors on one end to accommodate up to twelve wires. Coordinate connectors on end of the wiring harness to plug directly into the electric through-wire transfer hardware or wiring harness specified in hardware sets in Division 08 Sections "Door Hardware".
8. Electrical Knock Out Boxes: Factory weld 18 gage electrical knock out boxes to frame for electrical hardware preps; including but not limited to, electric through wire transfer hardware, electrical raceways and wiring harnesses, door position switches, electric strikes, magnetic locks, and jamb mounted card readers as specified in hardware sets in Division 08 Sections "Door Hardware" and "Access Control Hardware".
   a. Provide electrical knock out boxes with a dual 1/2-inch and 3/4-inch knockouts.
   b. Conduit to be coordinated and installed in the field (Division 26) from middle hinge box and strike box to door position box.
   c. Electrical knock out boxes to comply with NFPA requirements and fit electrical door hardware as specified in hardware sets in Division 08 Section "Door Hardware".
   d. Electrical knock out boxes for continuous hinges should be located in the center of the vertical dimension on the hinge jamb.

9. Floor Anchors: Weld anchors to bottom of jambs and mullions with at least four spot welds per anchor.
10. Jamb Anchors: Provide number and spacing of anchors as follows:
    a. Masonry Type: Locate anchors not more than 18 inches from top and bottom of frame. Space anchors not more than 32 inches o.c. and as follows:
        1) Two anchors per jamb up to 60 inches high.
        2) Three anchors per jamb from 60 to 90 inches high.
        3) Four anchors per jamb from 90 to 120 inches high.
        4) Four anchors per jamb plus 1 additional anchor per jamb for each 24 inches or fraction thereof above 120 inches high.
    b. Stud-Wall Type: Locate anchors not more than 18 inches from top and bottom of frame. Space anchors not more than 32 inches o.c. and as follows:
        1) Three anchors per jamb up to 60 inches high.
        2) Four anchors per jamb from 60 to 90 inches high.
        3) Five anchors per jamb from 90 to 96 inches high.
        4) Five anchors per jamb plus 1 additional anchor per jamb for each 24 inches or fraction thereof above 96 inches high.
        5) Two anchors per head for frames above 42 inches wide and mounted in metal-stud partitions.
    c. Postinstalled Expansion Type: Locate anchors not more than 6 inches from top and bottom of frame. Space anchors not more than 26 inches o.c.
    d. Severe Storm Shelter Openings: Provide jamb, head, and sill anchors in accordance with manufacturer'¢s tested and approved assemblies.
11. Door Silencers: Except on weather-stripped or gasketed doors, drill stops to receive door silencers as follows. Keep holes clear during construction. Silencers to be supplied by frame manufacturer regardless if specified in Division 08 Section "Door Hardware."
    a. Single-Door Frames: Drill stop in strike jamb to receive three door silencers.
    b. Double-Door Frames: Drill stop in head jamb to receive two door silencers.

E. Hardware Preparation: Factory prepare hollow metal work to receive templated mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping according to the Door Hardware Schedule and templates furnished as specified in Division 08 Section "Door Hardware."

1. Locate hardware as indicated, or if not indicated, according to ANSI/SDI A250.8.
2. Reinforce doors and frames to receive nontemplated, mortised and surface-mounted door hardware.
3. Comply with applicable requirements in ANSI/SDI A250.6 and ANSI/DHI A115 Series specifications for preparation of hollow metal work for hardware.
4. Coordinate locations of conduit and wiring boxes for electrical connections with Division 26 Sections.

2.8 STEEL FINISHES

A. Prime Finish: Clean, pretreat, and apply manufacturer's standard primer.

1. Shop Primer: Manufacturer's standard, fast-curing, lead- and chromate-free primer complying with SDI A250.10; recommended by primer manufacturer for substrate; compatible with substrate and field-applied coatings despite prolonged exposure.

2.9 ACCESSORIES

A. Mullions and Transom Bars: Join to adjacent members by welding or rigid mechanical anchors.

B. Grout Guards: Formed from same material as frames, not less than 0.016 inch thick.

PART 3 - EXECUTION

3.1 EXAMINATION

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

B. Examine roughing-in for embedded and built-in anchors to verify actual locations before frame installation.

C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

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

3.2 PREPARATION

A. Remove welded-in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces.

B. Drill and tap doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.

3.3 INSTALLATION

A. General: Install hollow-metal work plumb, rigid, properly aligned, and securely fastened in place. Comply with Drawings and manufacturer's written instructions.

B. Hollow-Metal Frames: Install hollow-metal frames of size and profile indicated. Comply with SDI A250.11 or NAAMM-HMMA 840 as required by standards specified.

1. Set frames accurately in position; plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces, leaving surfaces smooth and undamaged.
   a. At fire-rated openings, install frames according to NFPA 80.
   b. Where frames are fabricated in sections because of shipping or handling limitations, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces.
   c. Install frames with removable stops located on secure side of opening.
   d. Install door silencers in frames before grouting.
   e. Remove temporary braces necessary for installation only after frames have been properly set and secured.
   f. Check plumb, square, and twist of frames as walls are constructed. Shim as necessary to comply with installation tolerances.

g. Field apply bituminous coating to backs of frames that will be filled with grout containing antifreezing agents.

2. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, and secure with postinstalled expansion anchors.
   a. Floor anchors may be set with power-actuated fasteners instead of postinstalled expansion anchors if so indicated and approved on Shop Drawings.

3. Metal-Stud Partitions: Solidly pack mineral-fiber insulation inside frames.
4. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with grout.
5. Concrete Walls: Solidly fill space between frames and concrete with mineral-fiber insulation.
6. In-Place Concrete or Masonry Construction: Secure frames in place with postinstalled expansion anchors. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.
7. Installation Tolerances: Adjust hollow-metal door frames for squareness, alignment, twist, and plumb to the following tolerances:
   a. Squareness: Plus or minus 1/16 inch, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
   b. Alignment: Plus or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of wall.
   c. Twist: Plus or minus 1/16 inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
   d. Plumbness: Plus or minus 1/16 inch, measured at jambs at floor.

C. Hollow-Metal Doors: Fit hollow-metal doors accurately in frames, within clearances specified below. Shim as necessary.

1. Non-Fire-Rated Steel Doors:
   a. Between Door and Frame Jambs and Head: 1/8 inch plus or minus 1/32 inch.
   b. Between Edges of Pairs of Doors: 1/8 inch to 1/4 inch plus or minus 1/32 inch.
   c. At Bottom of Door: 5/8 inch plus or minus 1/32 inch.
   d. Between Door Face and Stop: 1/16 inch to 1/8 inch plus or minus 1/32 inch.

2. Fire-Rated Doors: Install doors with clearances according to NFPA 80.
3. Smoke-Control Doors: Install doors and gaskets according to NFPA 105.

D. Glazing: Comply with installation requirements in Section 088000 "Glazing" and with hollow-metal manufacturer's written instructions.

1. Secure stops with countersunk flat- or oval-head machine screws spaced uniformly not more than 9 inches o.c. and not more than 2 inches o.c. from each corner.

3.4 FIELD QUALITY CONTROL

A. Inspections:

1. Fire-Rated Door Inspections: Inspect each fire-rated door according to NFPA 80, section 5.2

B. Repair or remove and replace installations where inspections indicate that they do not comply with specified requirements.

C. Reinspect repaired or replaced installations to determine if replaced or repaired door assembly installations comply with specified requirements.

D. Prepare and submit separate inspection report for each fire-rated door assembly indicating compliance with each item listed in NFPA 80.

3.5 ADJUSTING AND CLEANING

A. Final Adjustments: Check and readjust operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including hollow-metal work that is warped, bowed, or otherwise unacceptable.

B. Remove grout and other bonding material from hollow-metal work immediately after installation.

C. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying, rust-inhibitive primer.

D. Metallic-Coated Surface Touchup: Clean abraded areas and repair with galvanizing repair paint according to manufacturer's written instructions.

END OF SECTION

SECTION 081116 - INTERIOR ALUMINUM FRAMES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Aluminum door and window frames.

B. Related Requirements:

1. Section 081416 - Flush Wood Doors.
2. Section 087100 - Door Hardware.
3. Section 088000 - Glazing.

1.2 SUBMITTALS

A. See Section 013300 - Submittal Procedures, for submittal requirements.

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. Verification Samples: Actual pieces of products in each finish specified, not less than 6 inches square or 6 inches long for linear components. For finishes subject to color variation, include not less than two samples illustrating extreme range to be anticipated.

1.3 QUALITY ASSURANCE

A. Manufacturer Qualifications: Not less than 5 years of experience in manufacturing components of the types specified.

B. Installer Qualifications: Firm with documented experience in installing components of the types specified.

C. Fire-Rated Frames: Tested in accordance with NFPA 252, listed and labeled by Underwriters Laboratories Inc..

1.4 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 under cover in manufacturer's packaging until installation.

1.5 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.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design: RACO Classic Frames as manufactured by RACO Interior Products, Inc.; www.racointeriors.com, or comparable product by one of the following:

1. Versatrac.
2. Wilson Partitions.

2.2 MATERIALS

A. Aluminum Sheet: ASTM B 209, alloy 5005-H14, stretcher leveled.

B. Extruded Aluminum: ASTM B 221, alloy 6063-T5 or alloy 6463-T5.

2.3 COMPONENTS

A. Aluminum Door Frames: Provide frames sized to fit wall thicknesses indicated on the drawings, in profiles indicated, and constructed from materials as follows:

1. Frame Members: Extruded aluminum shapes, not less than 0.062 in thick, reinforced at hinge and strike locations.
2. Corner Brackets: Extruded aluminum, fastened with stainless steel screws.
3. Trim: Extruded aluminum, not less than 0.062 in thick, removable snap-in type without exposed fasteners.
4. Replaceable Weatherstripping: AAMA 701/702 wool pile.
5. Glazing: As specified in Section 088000 - Glazing.

2.4 FINISHES

A. Clear Anodic Finish: AAMA 611, AA-M12C22A31, Class II, 0.010 mm or thicker.

2.5 FABRICATION

A. Aluminum frames: Sizes and contours as indicated on drawings.

2.6 ACCESSORIES

A. Fasteners: Aluminum, non-magnetic stainless steel, or other material warranted by manufacturer as non-corrosive and compatible with aluminum components.

B. 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 A 123/A 123M.

C. Bituminous Coating: Cold-applied asphaltic mastic, compounded for 30-mil thickness per coat.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that wall surfaces and openings are ready to receive frames and are within tolerances specified in manufacturer's instructions.

B. Verify that frames installed by other trades for installation of doors of this section are in strict accordance with recommendations and approved shop drawings and within tolerances specified in manufacturer's instructions.

3.2 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.

3.3 INSTALLATION

A. Install frames in accordance with manufacturer's instructions and approved shop drawings.

B. 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.

C. 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.

D. Install glass in frames as specified in Section 088000.

3.4 CLEANING

A. Upon completion of installation, thoroughly clean door and frame surfaces in accordance with AAMA 609.

B. Do not use abrasive, caustic, or acid cleaning agents.

3.5 PROTECTION

A. Protect products of this section from damage caused by subsequent construction until substantial completion.

B. Replace damaged or defective components that cannot be repaired to a condition indistinguishable from undamaged components.

END OF SECTION

SECTION 081416 - FLUSH WOOD DOORS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Solid-core doors with plastic laminate faces.

B. Related Requirements:

1. Section 088000 "Glazing" for glass view panels in flush wood doors.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of door. Include details of core and edge construction and trim for openings. Shop Drawings: Indicate location, size, and hand of each door; elevation of each kind of door; construction details not covered in Product Data; and the following:

1. Dimensions and locations of blocking.
2. Dimensions and locations of mortises and holes for hardware.
3. Dimensions and locations of cutouts.
4. Undercuts.
5. Fire-protection ratings for fire-rated doors.

B. Samples for Verification:

1. Corner sections of doors, approximately 8 by 10 inches, with door faces and edges representing actual materials to be used.
   a. Plastic laminate, 6 inches square, for each color, texture, and pattern selected.

2. Frames for light openings, 6 inches long, for each material, type, and finish required.

1.4 INFORMATIONAL SUBMITTALS

A. Sample Warranty: For special warranty.

B. Quality Standard Compliance Certificates: AWI Quality Certification Program certificates.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Comply with requirements of referenced standard and manufacturer's written instructions.

B. Package doors individually in plastic bags or cardboard cartons.

C. Mark each door on top and bottom rail with opening number used on Shop Drawings.

1.6 FIELD CONDITIONS

A. Environmental Limitations: Do not deliver or install doors until spaces are enclosed and weathertight, wet work in spaces is complete and dry, and HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during remainder of construction period.

1.7 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace doors that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:
   a. Warping (bow, cup, or twist) more than 1/4 inch in a 42-by-84-inch section.
   b. Telegraphing of core construction in face veneers exceeding 0.01 inch in a 3-inch span.
2. Warranty shall also include installation and finishing that may be required due to repair or replacement of defective doors.
3. Warranty Period for Solid-Core Interior Doors: Life of installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following, or comparable:

1. Algoma Hardwoods, Inc.
2. Eggers Industries.
3. Graham Wood Doors; an Assa Abloy Group company.
4. Marshfield Door Systems, Inc.
5. VT Industries, Inc.

B. Source Limitations: Obtain flush wood doors from single manufacturer.

2.2 FLUSH WOOD DOORS, GENERAL

A. Quality Standard: In addition to requirements specified, comply with AWI's, AWMAC's, and WI's "Architectural Woodwork Standards."

1. Contract Documents contain selections chosen from options in quality standard and additional requirements beyond those of quality standard. Comply with those selections and requirements in addition to quality standard.

B. WDMA I.S.1-A Performance Grade:

1. Heavy Duty unless otherwise indicated.
2. Extra Heavy Duty: Public toilets, janitor's closets, assembly spaces, and exits.
3. Standard Duty: Closets (not including janitor's closets) and private toilets.

C. Fire-Rated Wood Doors: Doors complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at positive pressure according to NFPA 252 or UL 10C.

1. Oversize Fire-Rated Door Assemblies: For units exceeding sizes of tested assemblies, provide certification by a qualified testing agency that doors comply with standard construction requirements for tested and labeled fire-rated door assemblies except for size.
2. Temperature-Rise Limit: At vertical exit enclosures and exit passageways, provide doors that have a maximum transmitted temperature end point of not more than 450 deg F above ambient after 30 minutes of standard fire-test exposure.
3. Cores: Provide core specified or mineral core as needed to provide fire-protection rating indicated.
4. Edge Construction: Provide edge construction with intumescent seals concealed by outer stile. Comply with specified requirements for exposed edges.
5. Pairs: Provide fire-retardant stiles that are listed and labeled for applications indicated without formed-steel edges and astragals. Provide stiles with concealed intumescent seals. Comply with specified requirements for exposed edges.

D. Particleboard-Core Doors:

1. Particleboard: ANSI A208.1, Grade LD-1 or Grade LD-2.
2. Blocking: Provide wood blocking in particleboard-core doors as follows:
   a. 5-inch top-rail blocking, in doors indicated to have closers.
   b. 10-inch bottom-rail blocking, in exterior doors and doors indicated to have kick, mop, or armor plates.
3. Provide doors with structural-composite-lumber cores instead of particleboard cores for doors indicated to receive exit devices.

E. Structural-Composite-Lumber-Core Doors:

1. Structural Composite Lumber: WDMA I.S.10.
   a. Screw Withdrawal, Face: 700 lbf.
   b. Screw Withdrawal, Edge: 400 lbf.

F. Mineral-Core Doors:

1. Core: Noncombustible mineral product complying with requirements of referenced quality standard and testing and inspecting agency for fire-protection rating indicated.
2. Blocking: Provide composite blocking with improved screw-holding capability approved for use in doors of fire-protection ratings indicated as follows:
   a. 5-inch top-rail blocking.
   b. 5-inch bottom-rail blocking, in doors indicated to have protection plates.
   c. 5-inch midrail blocking, in doors indicated to have armor plates.
   d. 5-inch midrail blocking, in doors indicated to have exit devices.
3. Edge Construction: At hinge stiles, provide laminated-edge construction with improved screw-holding capability and split resistance. Comply with specified requirements for exposed edges.
   a. Screw-Holding Capability: 550 lbf per WDMA T.M.-10.

2.3 PLASTIC-LAMINATE-FACED DOORS

A. Interior Solid-Core Doors:

1. Grade: Custom.
2. Plastic-Laminate Faces: High-pressure decorative laminates complying with NEMA LD 3, Grade HGS.
3. Colors, Patterns, and Finishes: As selected by Architect from laminate manufacturer's full range of products.

4. Exposed Vertical Edges: Plastic laminate that matches faces, applied before faces.
5. Exposed Top Edges: Hardwood edges for painting.
6. Core: Particleboard.
7. Construction: Five plies. Stiles and rails are bonded to core, then entire unit is abrasive planed before faces are applied. Faces are bonded to core using a hot press.

2.4 LIGHT FRAMES

A. Metal Frames: Manufacturer's standard frame formed of 0.048-inch- thick, cold-rolled steel sheet; with baked-enamel- or powder-coated finish; at fire-rated doors, approved for use in doors of fire-protection rating indicated on Drawings.

2.5 FABRICATION

A. Factory machine doors for hardware that is not surface applied. Locate hardware to comply with DHI-WDHS-3. Comply with final hardware schedules, door frame Shop Drawings, BHMA-156.115-W, and hardware templates.

1. Coordinate with hardware mortises in metal frames to verify dimensions and alignment before factory machining.
2. Metal Astragals: Factory machine astragals and formed-steel edges for hardware for pairs of fire-rated doors.

B. Transom and Side Panels: Fabricate matching panels with same construction, exposed surfaces, and finish as specified for associated doors. Finish bottom edges of transoms and top edges of rabbeted doors same as door stiles.

1. Fabricate door and transom panels with full-width, solid-lumber, rabbeted, meeting rails. Provide factory-installed spring bolts for concealed attachment into jambs of metal door frames.

C. Openings: Factory cut and trim openings through doors.

1. Light Openings: Trim openings with moldings of material and profile indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine doors and installed door frames, with Installer present, before hanging doors.

1. Verify that installed frames comply with indicated requirements for type, size, location, and swing characteristics and have been installed with level heads and plumb jambs.
2. Reject doors with defects.

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

3.2 INSTALLATION

A. Hardware: For installation, see Section 087100 "Door Hardware."

B. Installation Instructions: Install doors to comply with manufacturer's written instructions and referenced quality standard, and as indicated.

1. Install fire-rated doors according to NFPA 80.

C. Job-Fitted Doors: Align and fit doors in frames with uniform clearances and bevels as indicated below; do not trim stiles and rails in excess of limits set by manufacturer or permitted for fire-rated doors. Machine doors for hardware. Seal edges of doors, edges of cutouts, and mortises after fitting and machining.

1. Clearances: Provide 1/8 inch at heads, jambs, and between pairs of doors. Provide 1/8 inch from bottom of door to top of decorative floor finish or covering unless otherwise indicated. Where threshold is shown or scheduled, provide1/4 inch from bottom of door to top of threshold unless otherwise indicated.
   a. Comply with NFPA 80 for fire-rated doors.
2. Bevel non-fire-rated doors 1/8 inch in 2 inches at lock and hinge edges.
3. Bevel fire-rated doors 1/8 inch in 2 inches at lock edge; trim stiles and rails only to extent permitted by labeling agency.

3.3 ADJUSTING

A. Operation: Rehang or replace doors that do not swing or operate freely.

B. Finished Doors: Replace doors that are damaged or that do not comply with requirements. Doors may be repaired or refinished if Work complies with requirements and shows no evidence of repair or refinishing.

END OF SECTION

SECTION 083113 - ACCESS DOORS AND FRAMES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Access doors and frames for walls and ceilings.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, fire ratings, materials, individual components and profiles, and finishes.

B. Shop Drawings:

1. Include plans, elevations, sections, details, and attachments to other work.
2. Detail fabrication and installation of access doors and frames for each type of substrate.

C. Samples: For each door face material, at least 3 by 5 inches in size, in specified finish.

D. Product Schedule: Provide complete access door and frame schedule, including types, locations, sizes, latching or locking provisions, and other data pertinent to installation.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Rated Access Doors and Frames: Units complying with NFPA 80 that are identical to access door and frame assemblies tested for fire-test-response characteristics according to the following test method and that are listed and labeled by UL or another testing and inspecting agency acceptable to authorities having jurisdiction:

1. NFPA 252 or UL 10B for fire-rated access door assemblies installed vertically.
2. NFPA 288 for fire-rated access door assemblies installed horizontally.

2.2 MANUFACTURERS

A. Access Doors: Subject to compliance with requirements, provide indicated products by Milcor Inc., or comparable products by one of the following:

1. Acudor Products, Inc.
2. Babcock-Davis.
3. J. L. Industries, Inc.
4. Larsen's Manufacturing Company.
5. Nystrom, Inc.
6. Williams Bros. Corporation.

B. Source Limitations: Obtain each type of access door and frame from single source from single manufacturer.

2.3 ACCESS DOORS AND FRAMES FOR WALLS AND CEILINGS

A. Recessed Access Doors – Gypsum Board:

1. Locations: Gypsum board walls and ceilings.
2. Basis-of-Design Product: Milcor Inc.; Style DWR.
3. Assembly Description: Door face recessed 5/8 inch for application of gypsum board infill, with concealed flange for gypsum board installation and concealed hinge.
4. Door Size: As indicated on Drawings..
5. Galvanized Steel Sheet for Door: Nominal 0.060 inch, 16 gage, factory primed.
6. Frame Material: Same material and thickness as door.
7. Latch and Lock: Cam latch, screwdriver operated.

B. Flush Access Doors with Exposed Flanges

1. Locations: Masonry and tile walls.
2. Basis-of-Design Product: Milcor Inc.; Style M.
3. Assembly Description: Face of door flush with frame, with exposed flange and concealed hinge.
4. Stainless-Steel Sheet for Doors in Unpainted Walls: Nominal 0.062 inch, 16 gage, No. 4 finish.
5. Frame Material: Same material, thickness, and finish as door.
6. Hinges: Manufacturer's standard.
7. Latch and Lock: Cam latch, screwdriver operated.

2.4 FIRE-RATED ACCESS DOORS AND FRAMES

A. Fire-Rated, Flush Access Doors with Exposed Flanges:

1. Locations: Fire rated walls and ceilings.
2. Basis-of-Design Product: Milcor Inc.; Style UFR.
3. Description: Door face flush with frame, with a core of mineral-fiber insulation enclosed in sheet metal; with exposed flange, self-closing door, and concealed hinge.
4. Fire-Resistance Rating: Not less than that of adjacent construction.
5. Uncoated Steel Sheet for Door: Nominal 0.036 inch, 20 gage, factory primed.
6. Frame Material: Same material, thickness, and finish as door.
7. Latch and Lock: Self-latching door hardware.

2.5 FABRICATION

A. General: Provide access door and frame assemblies manufactured as integral units ready for installation.

B. Metal Surfaces: For metal surfaces exposed to view in the completed Work, provide materials with smooth, flat surfaces without blemishes. Do not use materials with exposed pitting, seam marks, roller marks, rolled trade names, or roughness.

C. Doors and Frames: Grind exposed welds smooth and flush with adjacent surfaces. Furnish attachment devices and fasteners of type required to secure access doors to types of supports indicated.

1. For concealed flanges with drywall bead, provide edge trim for gypsum board securely attached to perimeter of frames.
2. Provide mounting holes in frames for attachment of units to metal framing.

D. Latching Mechanisms: Furnish number required to hold doors in flush, smooth plane when closed.

1. For cylinder locks, furnish two keys per lock and key all locks alike.

2.6 FINISHES

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

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

3.2 INSTALLATION

A. Comply with manufacturer's written instructions for installing access doors and frames.

B. Install doors flush with adjacent finish surfaces or recessed to receive finish material.

3.3 ADJUSTING

A. Adjust doors and hardware, after installation, for proper operation.

B. Remove and replace doors and frames that are warped, bowed, or otherwise damaged.

END OF SECTION

SECTION 083323 - OVERHEAD COILING DOORS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Insulated service doors.

B. Related Sections:

1. Section 055000 "Metal Fabrications" for miscellaneous steel supports.

1.2 ACTION SUBMITTALS

A. Product Data: For each type and size of overhead coiling door and accessory. Include the following:

1. Construction details, material descriptions, dimensions of individual components, profiles for slats, and finishes.
2. Rated capacities, operating characteristics, electrical characteristics, and furnished accessories.

B. Shop Drawings: For each installation and for special components not dimensioned or detailed in manufacturer's product data.

1. Include plans, elevations, sections, details, and attachments to other work.
2. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Wiring Diagrams: For power, signal, and control wiring.
4. Include points of attachment and their corresponding static and dynamic loads imposed on structure.
5. For exterior components, include details of provisions for assembly expansion and contraction and for excluding and draining moisture to the exterior.
6. Samples for Initial Selection: Manufacturer's finish charts showing full range of colors and textures available for units with factory-applied finishes.

C. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below.

1. Curtain Slats: 12 inches long.
2. Bottom Bar: 6 inches long with sensor edge.
3. Hood: 6 inches square.

D. Delegated-Design Submittal: For overhead coiling doors 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. Summary of forces and loads on walls and jambs.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer.

1.4 CLOSEOUT SUBMITTALS

A. Special warranty.

B. Maintenance Data: For overhead coiling doors to include in maintenance manuals.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for both installation and maintenance of units required for this Project.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

1.6 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of doors that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, products that may be incorporated into the construction include, but are not limited to, the following:

1. Cornell Iron Works, Inc.
2. Cookson.
3. Overhead Door Corporation.

B. Source Limitations: Obtain overhead coiling doors from single source from single manufacturer.

1. Obtain operators and controls from overhead coiling-door manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Accessibility Standard: Comply with applicable provisions in the Texas Accessibility Standards.

B. Delegated Design: Design overhead coiling doors, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

C. Structural Performance, Exterior Doors: Exterior overhead coiling doors shall withstand the wind loads, the effects of gravity loads, and loads and stresses within limits and under conditions indicated according to SEI/ASCE 7.

1. Wind Loads: As indicated on Drawings.
2. Deflection Limits: Design overhead coiling doors to withstand design wind load without evidencing permanent deformation or disengagement of door components.

D. Windborne-Debris Impact Resistance, Exterior Doors: Provide overhead coiling doors that pass ASTM E1886 missile-impact and cyclic-pressure tests according to ASTM E1996.

1. Large-Missile Test: For overhead coiling doors located within 30 feet (9.1 m) of grade.
2. Small-Missile Test: For overhead coiling doors located between 30 feet (9.1 m) and 60 feet (18.3 m) above grade.

2.3 INSULATED SERVICE DOOR ASSEMBLY

A. Insulated Service Door: Overhead coiling door formed with curtain of interlocking metal slats.

B. Operation Cycles: Provide overhead coiling door components and operators capable of operating for not less than 50,000 cycles. One operation cycle is complete when a door is opened from the closed position to the fully open position and returned to the closed position.

1. Include tamperproof cycle counter.

C. Air Infiltration: Maximum rate of 0.4 cfm/sq. ft. at 15 and 25 mph when tested according to ASTM E283.

D. Door Curtain Material: Galvanized steel.

E. Door Curtain Slats: Flat profile slats of 1-7/8 inch to 3-1/4 inch center-to-center height.

1. Insulated Slat Interior Facing: Same material as exterior face.

F. Bottom Bar: Two angles, each not less than 1-1/2 by 1-1/2 by 1/8 inch thick; fabricated from manufacturer's standard galvanized steel, finished to match door.

G. Curtain Jamb Guides: Manufacturer's standard angles or channels and angles of same material and finish as curtain slats unless otherwise indicated.

H. Hood: Match curtain material and finish.

1. Shape: Round.
2. Mounting: Face of wall.

I. Locking Devices: Equip door with locking device assembly.

J. Retain "Locking Device Assembly" Subparagraph below if retaining "locking device assembly" option in "Locking Devices" Paragraph above.

1. Locking Device Assembly: Single-jamb side locking bars, operable with cylinder.

K. Electric Door Operator:

1. Usage Classification: Standard duty, up to 25 cycles per hour and up to 90 cycles per day.
2. Operator Location: Top or front of hood.

3. Safety: Listed according to UL 325 by a qualified testing agency for commercial or industrial use; moving parts of operator enclosed or guarded if exposed and mounted at 8 feet or lower.
4. Motor Exposure: Interior.
5. Motor Electrical Characteristics:
   a. Horsepower: As indicated; if not indicated, sufficient to start, accelerate, and operate door in either direction from any position at a speed not less than 8 in./sec. and not more than 12 in./sec., without exceeding nameplate ratings or service factor.
   b. Voltage: 115-VAC, single phase, 60 Hz.
6. Emergency Manual Operation: Chain type.
7. Obstruction-Detection Device: Automatic electric sensor edge on bottom bar.
   a. Sensor Edge Bulb Color: Black.
8. Control Station(s): Where indicated on Drawings.

L. Door Finish:

1. Baked Enamel or Powder Coated Finish: Color as selected by Architect from manufacturer's full range.

2.4 MATERIALS, GENERAL

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.5 DOOR CURTAIN MATERIALS AND CONSTRUCTION

A. Door Curtains: Fabricate overhead coiling-door curtain of interlocking flat metal slats, designed to withstand wind loading indicated, in a continuous length for width of door without splices. Unless otherwise indicated, provide slats of thickness and mechanical properties recommended by door manufacturer for performance, size, and type of door indicated, and as follows:

1. Steel Door Curtain Slats: Zinc-coated (galvanized), cold-rolled structural steel sheet; complying with ASTM A 653/A 653M, with G90zinc coating; nominal sheet thickness (coated) of 0.028 inchand as required to meet requirements.
2. Insulation: Fill slats for insulated doors with manufacturer’s R-8.0 thermal insulation complying with maximum flamespread and smoke developed indexes of 75 and 450, respectively, according to ASTM E 84. Enclose insulation completely within slat faces.

B. Curtain Jamb Guides: Manufacturer's standard angles or channels and angles of same material and finish as curtain slats unless otherwise indicated, with sufficient depth and strength to retain curtain, to allow curtain to operate smoothly, and to withstand loading. Slot bolt holes for guide adjustment. Provide removable stops on guides to prevent overtravel of curtain, and a continuous bar for holding windlocks.

2.6 HOOD

A. General: Form sheet metal hood to entirely enclose coiled curtain and operating mechanism at opening head. Match curtain material and finish. Contour to fit end brackets to which hood is attached. Roll and reinforce top and bottom edges for stiffness. Form closed ends for surface-mounted hoods and fascia for any portion of between-jamb mounting that projects beyond wall face. Equip hood with intermediate support brackets as required to prevent sagging.

1. Galvanized Steel: Nominal 0.028-inch-thick, hot-dip galvanized steel sheet with G90zinc coating, complying with ASTM A 653/A 653M.

2.7 LOCKING DEVICES

A. Slide Bolt: Fabricate with side-locking bolts to engage through slots in tracks for locking by padlock, located on both left and right jamb sides, operable from coil side.

B. Locking Device Assembly: Fabricate with cylinder lock, spring-loaded dead bolt, operating handle, cam plate, and adjustable locking bars to engage through slots in tracks.

1. Lock Cylinders: As specified in Section 087100 "Door Hardware".
2. Keys: Two for each cylinder.

C. Safety Interlock Switch: Equip power-operated doors with safety interlock switch to disengage power supply when door is locked.

2.8 CURTAIN ACCESSORIES

A. Weatherseals for Exterior Doors: Equip each exterior door with weather-stripping gaskets fitted to entire perimeter of door for a weathertight installation, unless otherwise indicated.

1. At door head, use 1/8-inch- thick, replaceable, continuous sheet secured to inside of hood.
2. At door jambs, use replaceable, adjustable, continuous, flexible, 1/8-inch-thick seals of flexible vinyl, rubber, or neoprene.

2.9 COUNTERBALANCING MECHANISM

A. General: Counterbalance doors by means of manufacturer's standard mechanism with an adjustable-tension, steel helical torsion spring mounted around a steel shaft and contained in a spring barrel connected to top of curtain with barrel rings. Use grease-sealed bearings or self-lubricating graphite bearings for rotating members.

B. Counterbalance Barrel: Fabricate spring barrel of manufacturer's standard hot-formed, structural-quality, welded or seamless carbon-steel pipe, of sufficient diameter and wall thickness to support rolled-up curtain without distortion of slats and to limit barrel deflection to not more than 0.03 in./ft.of span under full load.

C. Spring Balance: One or more oil-tempered, heat-treated steel helical torsion springs. Size springs to counterbalance weight of curtain, with uniform adjustment accessible from outside barrel. Secure ends of springs to barrel and shaft with cast-steel barrel plugs.

D. Torsion Rod for Counterbalance Shaft: Fabricate of manufacturer's standard cold-rolled steel, sized to hold fixed spring ends and carry torsional load.

E. Brackets: Manufacturer's standard mounting brackets of either cast iron or cold-rolled steel plate.

2.10 ELECTRIC DOOR OPERATORS

A. General: Equip service doors for electric door operation. Electric door operator assembly of size and capacity recommended and provided by door manufacturer for door specified, with electric motor and factory-prewired motor controls, starter, gear-reduction unit, solenoid-operated brake, clutch, remote-control stations, control devices, integral gearing for locking door, and accessories required for proper operation.

1. Comply with NFPA 70.
2. Provide control equipment complying with NEMA ICS 1, NEMA ICS 2, and NEMA ICS 6, with NFPA 70 Class 2 control circuit, maximum 24 V, ac or dc.

B. Usage Classification: Electric operator and components capable of operating for not less than number of cycles per hour indicated for each door.

C. Door Operator Location(s): Operator location indicated for each door.

1. Top-of-Hood Mounted: Operator is mounted to the right or left door head plate with the operator on top of the door-hood assembly and connected to the door drive shaft with drive chain and sprockets. Headroom is required for this type of mounting.
2. Front-of-Hood Mounted: Operator is mounted to the right or left door head plate with the operator on coil side of the door-hood assembly and connected to the door drive shaft with drive chain and sprockets. Front clearance is required for this type of mounting.

D. Motors: Reversible-type motor with controller (disconnect switch) for motor exposure indicated for each door assembly.

1. Electrical Characteristics: Minimum as indicated for each door assembly. If not indicated, large enough to start, accelerate, and operate door in either direction from any position, at a speed not less than 8 in./sec. and not more than 12 in./sec., without exceeding nameplate ratings or service factor.
2. Operating Controls, Controllers, Disconnect Switches, Wiring Devices, and Wiring: Manufacturer's standard unless otherwise indicated.
3. Coordinate wiring requirements and electrical characteristics of motors and other electrical devices with building electrical system and each location where installed.

E. Limit Switches: Equip each motorized door with adjustable switches interlocked with motor controls and set to automatically stop door at fully opened and fully closed positions.

F. Obstruction Detection Device: Equip motorized door with indicated external automatic safety sensor capable of protecting full width of door opening. For non-fire-rated doors, activation of device immediately stops and reverses downward door travel.

1. Sensor Edge: Automatic safety sensor edge, located within astragal or weather stripping mounted to bottom bar. Contact with sensor activates device. Connect to control circuit using manufacturer's standard take-up reel or self-coiling cable.
   a. Self-Monitoring Type: Four-wire configured device designed to interface with door operator control circuit to detect damage to or disconnection of sensor edge.

G. Control Station: Three-button control station in fixed location with momentary-contact push-button controls labeled "Open" and "Stop" and sustained- or constant-pressure push-button control labeled "Close."

1. Interior units, full-guarded, recessed, heavy-duty type, with general-purpose NEMA ICS 6, Type 1 enclosure.

2. Exterior units, full-guarded, standard-duty, surface-mounted, weatherproof type, NEMA ICS 6, Type 4 enclosure, key operated.

H. Emergency Manual Operation: Equip each electrically powered door with capability for emergency manual operation. Design manual mechanism so required force for door operation does not exceed 25 lbf.

I. Emergency Operation Disconnect Device: Equip operator with hand-operated disconnect mechanism for automatically engaging manual operator and releasing brake for emergency manual operation while disconnecting motor without affecting timing of limit switch. Mount mechanism so it is accessible from floor level. Include interlock device to automatically prevent motor from operating when emergency operator is engaged.

J. Motor Removal: Design operator so motor may be removed without disturbing limit-switch adjustment and without affecting emergency manual operation.

2.11 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.12 STEEL AND GALVANIZED-STEEL FINISHES

A. Baked-Enamel or Powder-Coat Finish: Manufacturer's standard baked-on finish consisting of prime coat and thermosetting topcoat. Comply with coating manufacturer's written instructions for cleaning, pretreatment, application, and minimum dry film thickness.

1. Color as selected by Architect from full range of manufacturer's premium powder coat finish options.
2. Interior Curtain-Slat Facing: Match finish of exterior curtain-slat face.

PART 3 - EXECUTION

3.1 EXAMINATION

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

B. Examine locations of electrical connections.

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

3.2 INSTALLATION

A. Install overhead coiling doors and operating equipment complete with necessary hardware, anchors, inserts, hangers, and equipment supports; according to manufacturer's written instructions and as specified.

B. Install overhead coiling doors, hoods, and operators at the mounting locations indicated for each door.

C. Accessibility: Install overhead coiling doors, switches, and controls along accessible routes in compliance with regulatory requirements for accessibility.

3.3 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

1. Perform installation and startup checks according to manufacturer's written instructions.
2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
3. Test door closing when activated by detector or alarm-connected fire-release system. Reset door-closing mechanism after successful test.

3.4 ADJUSTING

A. Adjust hardware and moving parts to function smoothly so that doors operate easily, free of warp, twist, or distortion.

B. Lubricate bearings and sliding parts as recommended by manufacturer.

C. Adjust seals to provide weathertight fit around entire perimeter.

3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain overhead coiling doors.

END OF SECTION 083323

SECTION 084113 - ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Storefront framing.
2. Entrance doors.

B. Related Sections:

1. Section 087100 “Door Hardware” for entrance door hardware.
2. Section 088000 “Glazing” for glass.

1.2 PERFORMANCE REQUIREMENTS

A. General Performance: Aluminum-framed systems shall withstand the effects of the following performance requirements without exceeding performance criteria or failure due to defective manufacture, fabrication, installation, or other defects in construction:

1. Movements of supporting structure indicated on Drawings including, but not limited to, deflection from uniformly distributed and concentrated live loads.
2. Dimensional tolerances of building frame and other adjacent construction.
3. Failure includes the following:
   a. Deflection exceeding specified limits.
   b. Thermal stresses transferring to building structure.
   c. Framing members transferring stresses, including those caused by thermal and structural movements to glazing.
   d. Glazing-to-glazing contact.
   e. Noise or vibration created by wind and by thermal and structural movements.
   f. Loosening or weakening of fasteners, attachments, and other components.
   g. Sealant failure.
   h. Failure of operating units.

B. Delegated Design: Design aluminum-framed systems, including comprehensive engineering analysis by a qualified professional engineer licensed in the state of Texas, using performance requirements and design criteria indicated.

C. Wind Loads: Provide entrance and storefront systems, including anchorage, capable of withstanding wind-load design pressures calculated according to the requirements of authorities having jurisdiction or of the American Society of Civil Engineers ASCE 7 “Minimum Design Loads for Buildings and Other Structures”, analytical procedure, whichever is more stringent, using the factors indicated on the Drawings.

D. Deflection of Framing Members:

1. Deflection Normal to Wall Plane: Limited to 1/175 of clear span for spans up to 13 feet 6 inches and to 1/240 of clear span plus 1/4 inch for spans greater than 13 feet 6 inches or an amount that restricts edge deflection of individual glazing lites to 3/4 inch, whichever is less.
2. Deflection Parallel to Glazing Plane: Limited to L/360 of clear span or 1/8 inch, whichever is smaller.

E. Air Infiltration:

1. Fixed Framing and Glass Area: Provide aluminum-framed systems with maximum air leakage through fixed glazing and framing areas of 0.06 cfm/sq. ft. of fixed wall area when tested according to ASTM E 283 at a minimum static-air-pressure difference of 6.24 lbf/sq. ft.
2. Entrance Doors:
   a. Single Doors: Maximum air leakage of 0.5 cfm/sq. ft. at a static-air-pressure differential of 1.57 lbf/sq. ft..
   b. Pair of Doors: Maximum air leakage of 1.0 cfm/sq. ft. at a static-air-pressure differential of 1.57 lbf/sq. ft..

F. Water Penetration under Static Pressure: Test according to ASTM E 331 as follows:

1. No evidence of water penetration through fixed glazing and framing areas when tested according to a minimum static-air-pressure differential of 20 percent of positive wind-load design pressure, but not less than 10 lbf/sq. ft.

G. Thermal Movements: Allow for thermal movements resulting from ambient and surface temperature changes:

1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.
2. Thermal Cycling: No buckling; stress on glass; sealant failure; excess stress on framing, anchors, and fasteners; or reduction of performance when tested according to AAMA 501.5.
   a. High Exterior Ambient-Air Temperature: That which produces an exterior metal-surface temperature of 240 deg F.
   b. Low Exterior Ambient-Air Temperature: 0 deg F.
   c. Interior Ambient-Air Temperature: 75 deg F.

H. Windborne-Debris Impact Resistance: Pass missile-impact and cyclic-pressure tests when tested according to ASTM E 1886 and testing information in ASTM E 1996 for Wind Zone indicated.

1. Large-Missile Test: For glazed openings located within 30 feet of grade.
2. Small-Missile Test: For glazed openings located more than 30 feet above grade.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for aluminum-framed systems.

B. Shop Drawings: For aluminum-framed systems. Include plans, elevations, sections, details, and attachments to other work, and structural analysis data signed and sealed by the qualified professional engineer responsible for their preparations, and licensed in the State of Texas.

1. Include details of provisions for system expansion and contraction.
2. For entrance doors, include hardware schedule and indicate operating hardware types, functions, quantities, and locations.
3. Include computer analysis / thermographic diagrams indicating compliance with thermal performance requirements.

C. Samples for Verification: For each type of exposed finish required, in manufacturer's standard sizes.

D. Entrance Door Hardware Schedule: Prepared by or under the supervision of supplier, detailing fabrication and assembly of entrance door hardware, as well as procedures and diagrams. Coordinate final entrance door hardware schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of entrance door hardware.

E. Delegated-Design Submittal: For aluminum-framed 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.

1. Detail fabrication and assembly of aluminum-framed systems.
2. Include design calculations.

F. Product Test Reports: For the following tests, performed by a qualified testing agency.

1. Structural performance.
2. Air infiltration.
3. Water penetration.

G. Field quality-control reports.

H. Sample Warranties: For manufacturer's warranties.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.

B. Engineering Responsibility: Prepare data for aluminum-framed systems, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in systems similar to those indicated for this Project. Provide design and calculations signed and sealed by the Professional Engineer responsible for their preparation.

C. Product Options: Information on Drawings and in Specifications establishes requirements for systems' aesthetic effects and performance characteristics. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction. Performance characteristics are indicated by criteria subject to verification by one or more methods including preconstruction testing, field testing, and in-service performance.

1. Do not revise intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If revisions are proposed, submit comprehensive explanatory data to Architect for review.

D. Source Limitations for Aluminum-Framed Systems: Obtain from single source from single manufacturer.

E. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.

1. Build mockup of typical wall area as shown on Drawings.
2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
3. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

F. Preinstallation Conference: Conduct conference at Project site.

1. Include the following attendees at a minimum:
   a. Construction Manager,
   b. Superintendent
   c. Subcontractor Foreman
   d. Architect,
   e. Air barrier and flashing subcontractors for tie-in, as appropriate.

2. The following topics will need to be addressed along with normal pre-construction requirements:
   a. Delivery and storage requirements;
   b. Shop mock-up requirements;
   c. Field mock-up requirements;
   d. Factory Quality Control testing;
   e. Field Quality Control testing;
   f. Tie-in to adjacent materials;
   g. Schedule.

1.5 PROJECT CONDITIONS

A. Field Measurements: Verify actual locations of structural supports for aluminum-framed systems by field measurements before fabrication and indicate measurements on Shop Drawings.

1.6 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of aluminum-framed systems that do not comply with requirements or that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:
   a. Structural failures including, but not limited to, excessive deflection.
   b. Noise or vibration caused by thermal movements.
   c. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
   d. Adhesive or cohesive sealant failures.
   e. Failure of operating components.
   f. Water or air leakage through fixed glazing and framing areas.

2. Warranty Period: 10 years from date of Substantial Completion.

B. Special Finish Warranty: Standard form in which manufacturer agrees to repair finishes or replace aluminum that shows evidence of deterioration of factory-applied finishes within specified warranty period.

1. Deterioration includes, but is not limited to, the following:
   a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
   b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
   c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

2. Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design: Subject to compliance with requirements, provide storefront system manufactured by Kawneer NA, www.kawneer.com, or comparable product by one of the following:

1. EFCO Corporation: www.efcocorp.com.
2. Oldcastle Building Envelope: www.oldcastlebe.com
3. US Aluminum: www.usalum.com
4. YKK AP America Inc.; www.ykkap.com.

2.2 MATERIALS

A. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.

1. Sheet and Plate: ASTM B 209.
2. Extruded Bars, Rods, Profiles, and Tubes: ASTM B 221.
3. Extruded Structural Pipe and Tubes: ASTM B 429.
4. Structural Profiles: ASTM B 308/B 308M.

B. Steel Reinforcement:

1. Structural Shapes, Plates, and Bars: ASTM A 36/A 36M.
2. Cold-Rolled Sheet and Strip: ASTM A 1008/A 1008M.
3. Hot-Rolled Sheet and Strip: ASTM A 1011/A 1011M.
4. Primer: Manufacturer's standard zinc-rich, corrosion-resistant primer, complying with SSPC-PS Guide No. 12.00; applied immediately after surface preparation and pretreatment. Select surface preparation methods according to recommendations in SSPC-SP COM and prepare surfaces according to applicable SSPC standard.

2.3 STOREFRONT SYSTEMS

A. Basis-of-Design: Kawneer IR 501T Framing System.

1. Framing Members: Manufacturer's standard extruded-aluminum framing members of thickness required and reinforced as required to support imposed loads.
2. Size: 2-3/4 inches x 5 inches.
3. Construction: Thermally broken.
4. Glazing System: Retained mechanically with gaskets on four sides.
5. Glazing Plane: Center.
6. Finish: High-performance organic finish.
7. Fabrication Method: Field-fabricated stick system.
8. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
9. Steel Reinforcement: As required by manufacturer.

B. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.

C. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.

1. Use self-locking devices where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration.
2. Reinforce members as required to receive fastener threads.
3. Use exposed fasteners with countersunk Phillips screw heads, fabricated from stainless steel.

D. Concrete and Masonry Inserts: Hot-dip galvanized cast-iron, malleable-iron, or steel inserts, complying with ASTM A 123/A 123M or ASTM A 153/A 153M.

E. Framing System Gaskets and Sealants: Manufacturer's standard, recommended by manufacturer for joint type for smoke infiltration.

F. Stools: Provide custom sized aluminum stool extensions as indicated.

2.4 ENTRANCE DOOR SYSTEMS

A. Entrance Doors: Glazed impact-resistant entrance doors for manual-swing operation.

1. Basis-of-Design: Kawneer 350 IR Entrance
2. Door Construction: 1-3/4 inches thick. Welded corner construction.
3. Door Design: Medium stile; 3-1/2 inch wide stiles and top rail, 10-inch wide bottom rail; for 1 inch thick glass.
4. Glazing Stops and Gaskets: Square, snap-on, extruded-aluminum stops and preformed gaskets.
   a. Provide non-removable glazing stops on outside of door.
5. Finish: Match adjacent framing.

B. Entrance Door Hardware: Hardware is specified in Section 087100 "Door Hardware."

2.5 GLAZING SYSTEMS

A. Glazing: As specified in Section 088000 "Glazing," impact-resistant insulating.

B. Glazing Gaskets: Manufacturer's standard compression types; replaceable, molded or extruded, of profile and hardness required to maintain watertight seal.

C. Spacers and Setting Blocks: Manufacturer's standard elastomeric type.

D. Bond-Breaker Tape: Manufacturer's standard TFE-fluorocarbon or polyethylene material to which sealants will not develop adhesion.

2.6 ACCESSORY MATERIALS

A. Joint Sealants: For installation at perimeter of aluminum-framed systems, as specified in Section 079200 "Joint Sealants."

B. Bituminous Paint: Cold-applied, asphalt-mastic paint complying with SSPC-Paint 12 requirements except containing no asbestos; formulated for 30-mil thickness per coat.

2.7 FABRICATION

A. Form or extrude aluminum shapes before finishing.

B. Weld in concealed locations to greatest extent possible to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.

C. Framing Members, General: Fabricate components that, when assembled, have the following characteristics:

1. Profiles that are sharp, straight, and free of defects or deformations.
2. Accurately fitted joints with ends coped or mitered.
3. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
4. Provisions for field replacement of glazing from interior.
5. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.

D. Mechanically Glazed Framing Members: Fabricate for flush glazing without projecting stops.

E. Storefront Framing: Fabricate components for assembly using screw-spline system.

F. Entrance Door Frames: Reinforce as required to support loads imposed by door operation and for installing entrance door hardware.

1. At interior doors, provide silencers at stops to prevent metal-to-metal contact. Install three silencers on strike jamb of single-door frames and two silencers on head of frames for pairs of doors.

G. Entrance Doors: Reinforce doors as required for installing entrance door hardware.

H. Entrance Door Hardware Installation: Factory install entrance door hardware to the greatest extent possible. Cut, drill, and tap for factory-installed entrance door hardware before applying finishes.

I. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.

2.8 ALUMINUM FINISHES

A. High-Performance Organic Finish, Mica Fluoropolymer: Two-coat fluoropolymer finish complying with AAMA 2605, with suspended mica flakes containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

1. Color: As indicated.

B. Concealed Finish: Apply pretreatment and manufacturer's standard white or light-colored acrylic or polyester backer finish consisting of prime coat and wash coat with a minimum total dry film thickness of 0.5 mil.

PART 3 - EXECUTION

3.1 EXAMINATION

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

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

3.2 INSTALLATION

A. General:

1. Comply with manufacturer's written instructions.
2. Do not install damaged components.
3. Fit joints to produce hairline joints free of burrs and distortion.
4. Rigidly secure nonmovement joints.
5. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration.
6. Seal joints air and smoke tight unless otherwise indicated.

B. Metal Protection:

1. Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer or applying sealant or tape, or by installing nonconductive spacers as recommended by manufacturer for this purpose.
2. Where aluminum will contact concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.

C. Install components to drain water passing joints, condensation occurring within framing members and moisture migrating with the system to the exterior.

D. Install components plumb and true in alignment with established lines and grades, and without warp or rack.

E. Install continuous sill members and flashing in full sealant bed to produce weathertight installation.

F. Install glazing as specified in Section 088000 "Glazing."

G. Install dual lines of perimeter joint sealant to produce weathertight installation, typical.

H. Entrance Doors: Install doors to produce smooth operation and tight fit at contact points.

1. Field-Installed Entrance Door Hardware: Install surface-mounted entrance door hardware according to entrance door hardware manufacturers' written instructions using concealed fasteners to greatest extent possible.

3.3 ERECTION TOLERANCES

A. Install aluminum-framed systems to comply with the following maximum erection tolerances:

1. Location and Plane: Limit variation from true location and plane to 1/8 inch in 12 feet; 1/4 inch over total length.
2. Alignment:
   a. Where surfaces abut in line, limit offset from true alignment to 1/16 inch.
   b. Where surfaces meet at corners, limit offset from true alignment to 1/32 inch.

B. Diagonal Measurements: Limit difference between diagonal measurements to 1/8 inch.

3.4 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections.

B. Testing Services: Testing and inspecting of representative areas to determine compliance of installed systems with specified requirements shall take place as follows and in successive phases as indicated on Drawings. Do not proceed with installation of the next area until test results for previously completed areas show compliance with requirements.

C. Field Quality-Control Testing: Perform the following tests on representative areas of aluminum-framed entrances and storefronts:

1. Water-Spray Test: Before installation of interior finishes has begun, areas designated by Architect shall be tested according to AAMA 501.2 and shall not evidence water penetration.
2. Air Infiltration: Areas shall be tested for air leakage of 1.5 times the rate specified for laboratory testing under "Performance Requirements" Article, but not more than 0.09 cfm/sq. ft., of fixed wall area when tested according to ASTM E 783 at a minimum static-air-pressure difference of 1.57 lbf/sq. ft. Provide minimum of 1 test per representative area.
3. Water Penetration: ASTM E 1105 at a minimum static-air-pressure difference of 0.67 times the static air pressure differential specified for laboratory testing in “Performance Requirements• Article, but not less than 6.24 lbf/sq ft, and shall not evidence water penetration.

D. Remedial measures conducted on the test specimens to achieve passing results are to be incorporated into previous and future installations and reflected in the as-built shop drawings.

E. Repair or remove work if test results and inspections indicate that it does not comply with specified requirements.

F. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

G. Aluminum-framed assemblies will be considered defective if they do not pass tests and inspections.

H. Prepare test and inspection reports.

3.5 ADJUSTING

A. Adjust operating entrance door hardware to function smoothly as recommended by manufacturer.

1. For entrance doors accessible to people with disabilities, adjust closers to provide a 3-second closer sweep period for doors to move from a 70-degree open position to 3 inches from the latch, measured to the leading door edge.

END OF SECTION

SECTION 084229 –AUTOMATIC SLIDING ENTRANCES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:

1. Interior sliding, power-operated automatic entrances.

B. Related Requirements:

1. Section 084243 "Intensive Care/Critical Care Unit (ICU/CCU) Entrances" for sliding, manual ICU/CCU entrance door assemblies.
2. Section 087113 "Automatic Door Operators" for low energy swinging automatic door operators.

1.2 DEFINITIONS

A. AAADM: American Association of Automatic Door Manufacturers.

B. Activation Device: A control that, when actuated, sends an electrical signal to the door operator to open the door.

C. IBC: International Building Code.

D. Safety Device: A control that, to avoid injury, prevents a door from opening or closing.

E. For automatic door terminology, refer to BHMA A156.10 for definitions of terms.

1.3 COORDINATION

A. Templates: Distribute for doors, frames, and other work specified to be factory prepared for installing automatic entrances.

B. Coordinate hardware with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish. Coordinate hardware for automatic entrances with hardware required for rest of Project.

C. Electrical and Security System Roughing-in: Coordinate layout and installation of automatic entrances with connections to power supplies and access-control and security systems.

D. System Integration: Integrate sliding automatic entrances with other systems as required for a complete working installation.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for automatic entrances.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings: For sliding automatic entrances.

1. Include plans, elevations, sections, hardware mounting heights, and attachment details.
2. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include diagrams for power, signal, and control wiring.
4. Include integration with access control and security systems.
5. Indicate locations of activation and safety devices.
6. Include hardware schedule and indicate hardware types, functions, quantities, and locations.

C. Samples for Verification: For each type of exposed finish required, in manufacturer's standard sizes.

D. Delegated-Design Submittal: For automatic entrances.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Product Certificates: For each type of automatic entrance. Include emergency-exit features of automatic entrances serving as a required means of egress.

C. Test Reports: Certified test reports from UL, CUL, and ICBO indicating doors comply with specified performance requirements.

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

1.7 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For automatic entrances, safety devices, and control systems to include in operation and maintenance manuals.

1. Include troubleshooting and preventative maintenance instructions.

B. Provide any special tools or devices needed to setup, adjust, and service equipment at no additional cost to the owner.

1.8 QUALITY ASSURANCE

A. Manufacturer Qualifications: A manufacturer with Company Certificate issued by AAADM indicating that manufacturer has a Certified Inspector on staff.

1. Single Source Responsibility: Furnish door, frame, operator, and sensor components by same manufacturer.

B. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation and maintenance of units required for this Project, with minimum of 2 years experience in installation of similar doors.

1. Maintenance Proximity: Not more than two hours' normal travel time from Installer's place of business to Project site.

C. Certified Inspector Qualifications: Certified by AAADM.

1.9 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of automatic entrances that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:
   a. Structural failures including, but not limited to, excessive deflection.
   b. Faulty operation of operators, controls, and hardware.
   c. Deterioration of metals, metal finishes, and other materials beyond normal weathering and use.

2. Warranty Period: Two years from date of Substantial Completion.

B. Special Finish Warranty: Manufacturer agrees to repair or replace components on which finishes fail in materials or workmanship within specified warranty period.

1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 AUTOMATIC ENTRANCE ASSEMBLIES

A. Source Limitations: Obtain sliding automatic entrances from single source from single manufacturer.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Power-Operated Door Standard: BHMA A156.10.

2.2 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design automatic entrances.

B. Structural Performance: Automatic entrances shall withstand the effects of gravity, wind, and seismic loads in accordance with ASCE/SEI 7 using the criteria indicated on the Drawings..

C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.

1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

D. Operating Temperature Range: Automatic entrances shall operate within minus 20 to plus 122 deg F.

E. Air Infiltration: Maximum air leakage through fixed glazing and framing areas of 1.25 cfm/sq. ft. of fixed entrance-system area when tested according to ASTM E 283 at a minimum static-air-pressure difference of 1.57 lbf/sq. ft.

F. Opening Force:

1. Power-Operated Doors: Not more than 50 lbf required to manually set door in motion if power fails, and not more than 15 lbf required to open door to minimum required width.
2. Breakaway Device for Power-Operated Doors: Not more than 50 lbf required for a breakaway door or panel to open.

G. Entrapment-Prevention Force:

1. Power-Operated Sliding Doors: Not more than 30 lbf required to prevent stopped door from closing.

2.3 SLIDING AUTOMATIC ENTRANCES

A. General: Provide manufacturer's standard automatic entrances, including doors, sidelites, framing, headers, carrier assemblies, roller tracks, door operators, controls, and accessories required for a complete installation.

B. Manufacturers: Subject to compliance with requirements, provide one of the following:

1. ASSA ABLOY Entrance Systems; www.assaabloyentrance.us.
2. Horton Automatics: www.hortondoors.com.
3. Stanley Access Technologies: www.stanleyaccesstechnologies.com.
4. NABCO Entrances, Inc: www.nabcoentrances.com.

C. Configuration: Biparting-sliding doors with two sliding leaves and sidelites on each side.

1. Basis-of-Design: Whisper Slide GT1175 Telescoping Door as manufacted by NABCO Entrances, Inc.
2. Traffic Pattern: Two way.
3. Emergency Breakaway Capability: Sliding leafs and sidelite.
4. Mounting: Between jambs.

D. Operator Features:

1. Power opening and closing.
2. Drive System: Tooth-drive belt.
3. Adjustable opening and closing speeds.
4. Adjustable hold-open time between zero and 30 seconds.
5. Obstruction recycle.
6. 5-position switch to control electric power to operator and set operaton mode, key operated.
7. Battery back-up to operate doors, including sensors, for 100 cycles.

E. Controls: Activation and safety devices according to BHMA standards.

1. Activation Device: Motion sensor mounted on each side of door header to detect pedestrians in activating zone and to open door.
2. Safety Device: Presence sensor mounted on each side of door header to detect pedestrians in presence zone and to prevent door from closing.
3. Opening-Width Control: Two-position switch that in the normal position allows sliding doors to travel to full opening width and in the alternate position reduces opening to a selected partial opening width.

F. Additional Features for Exterior Entrances:

1. Exit Device: Surface-mounted exit device with concealed vertical rods engaging the operator. Exit device guards against doors being pulled open from the exterior side upon power outage.
   a. Basis-of-Design: Adams Rite 8600 with option for exterior key access.

2. Fail-safe electric lock that deactivates lock and engages vertical rod of exit device upon power outage.

G. Finish: Finish framing, door(s), and header with Class I, clear anodic finish.

2.4 ENTRANCE COMPONENTS

A. Framing Members: Extruded aluminum, minimum 0.125 inch thick and reinforced as required to support imposed loads.

1. Nominal Size: 1-3/4 by 4-1/2 inches.
2. Extruded Glazing Stops and Applied Trim: Minimum 0.062-inch wall thickness.

B. Stile and Rail Doors: 1-3/4-inch- thick, glazed doors with minimum 0.125-inch- thick, extruded-aluminum tubular stile and rail members. Mechanically fasten corners with reinforcing brackets that are welded, or incorporate concealed tie-rods that span full length of top and bottom rails.

1. Glazing Stops and Gaskets: Square, snap-on, extruded-aluminum stops and preformed gaskets.
2. Stile Design: Narrow stile, 2-1/8-inch nominal width.
3. Rail Design: 5-inch nominal height 6-1/2-inch nominal height 10-inch nominal height.
4. Muntin Bars: Horizontal tubular rail member for each door; match stile design and finish.

C. Sidelite: Match door construction.

D. Headers: Fabricated from minimum 0.125-inch- thick extruded aluminum and extending full width of automatic entrance units to conceal door operators and controls. Provide hinged or removable access panels for service and adjustment of door operators and controls. Secure panels to prevent unauthorized access.

1. Capacity: Capable of supporting doors of up to 220 lbper leaf over spans of up to 16 feet without intermediate supports.
   a. Provide sag rods for spans exceeding 16 feet.

E. Brackets and Reinforcements: High-strength aluminum with nonstaining, nonferrous shims for aligning system components.

F. Sliding-Door Carrier Assemblies and Overhead Roller Tracks: Carrier assembly that allows vertical adjustment; consisting of nylon- or delrin-covered, ball-bearing-center steel wheels operating on a continuous roller track, or ball-bearing-center steel wheels operating on a nylon- or delrin-covered, continuous roller track. Support doors from carrier assembly by cantilever and pivot assembly.

1. Rollers: Minimum of two ball-bearing roller wheels and two antirise rollers for each active leaf.

G. Sliding-Door Threshold: Threshold members and bottom-guide-track system with stainless-steel, ball-bearing-center roller wheels, continuous across full width of doors and sidelites.

1. Configuration: Flush threshold for interior doors.

H. Signage: As required by cited BHMA standard.

1. Application Process: Decals.
2. Provide sign materials with instructions for field application after glazing is installed.

2.5 MATERIALS

A. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.

1. Extrusions: ASTM B 221.
2. Sheet: ASTM B 209.

B. Steel Reinforcement: Reinforcement with corrosion-resistant primer complying with SSPC-PS Guide No. 12.00 applied immediately after surface preparation and pretreatment. Use surface preparation methods according to recommendations in SSPC-SP COM and prepare surfaces according to applicable SSPC standard.

C. Glazing: As specified in Section 088000 "Glazing," 1/4 inch glass thickness for interior doors.

D. Sealants and Joint Fillers: As specified in Section 079200 "Joint Sealants."

E. Nonmetallic, Shrinkage-Resistant Grout: Premixed, nonmetallic, noncorrosive, nonstaining grout; complying with ASTM C 1107/C 1107M; of consistency suitable for application.

F. Bituminous Coating: Cold-applied asphalt emulsion complying with ASTM D 1187/D 1187M.

G. Fasteners and Accessories: Corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.

2.6 DOOR OPERATORS AND CONTROLS

A. General: Provide operators and controls, which include activation and safety devices, according to BHMA standards, for condition of exposure, and for long-term, maintenance-free operation under normal traffic load for type of occupancy indicated.

B. Door Operators: Provide door operators of size recommended by manufacturer for door size, weight, and movement.

1. Door Operator Performance: Door operators shall open and close doors and maintain them in fully closed position when subjected to Project's design wind loads.
2. Electromechanical Operators: Concealed, self-contained, overhead units powered by fractional-horsepower, permanent-magnet dc motor; with closing speed controlled mechanically by gear train and dynamically by braking action of electric motor; with solid-state microprocessor controller; complying with UL 325; and with manual operation with power off.

C. Motion Sensors: Self-contained, K-band-frequency, microwave-scanner units; fully enclosed by their plastic housings; adjustable to provide detection-field sizes and functions required by BHMA A156.10.

1. Provide capability for switching between bi- and unidirectional detection.
2. For one-way traffic, sensor on egress side shall not be active when doors are fully closed.

D. Presence Sensors: Self-contained, active-infrared scanner units; adjustable to provide detection-field sizes and functions required by BHMA A156.10. Sensors shall remain active at all times.

E. Photoelectric Beams: Pulsed infrared, sender-receiver assembly for recessed mounting. Beams shall not be active when doors are fully closed.

F. Activation Device: Touchless switch to activate door operator.

G. Electrical Interlocks: Unless units are equipped with self-protecting devices or circuits, provide electrical interlocks to prevent activation of operator when door is locked, latched, or bolted.

2.7 HARDWARE

A. General: Provide units in sizes and types recommended by automatic entrance and hardware manufacturers for entrances and uses indicated. Finish exposed parts to match door finish.

B. Breakaway Device for Power-Operated Doors: Device that allows door to swing out in direction of egress to full 90 degrees from any operating position. Maximum force to open door shall be as stipulated in "Performance Requirements" Article. Interrupt powered operation of door operator while in breakaway mode.

1. Include one adjustable detent device mounted at the top of each breakaway panel to control breakaway force.
   a. Panel Closer: Factory-installed concealed hydraulic door closer to close and latch panels after they are swung out manually in a panic situation.
   b. Limit Arms: Limit swing to 90 degrees, spring loaded with adjustable friction damping.

C. Weather Stripping: Replaceable components.

1. Sliding Type: AAMA 701/702, made of wool, polypropylene, or nylon woven pile with nylon-fabric or aluminum-strip backing.

2.8 FABRICATION

A. General: Factory fabricate automatic entrance components to designs, sizes, and thicknesses indicated and to comply with indicated standards.

1. Form aluminum shapes before finishing.
2. Weld in concealed locations to greatest extent possible to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.
3. Use concealed fasteners to greatest extent possible. Where exposed fasteners are required, use countersunk Phillips flat-head machine screws, finished to match framing.
   a. Where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration, use self-locking devices.
   b. Reinforce members as required to receive fastener threads.
4. Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer or by applying sealant or tape recommended by manufacturer for this purpose.

B. Framing: Provide automatic entrances as prefabricated assemblies. Complete fabrication, assembly, finishing, hardware application, and other work before shipment to Project site.

1. Fabricate tubular and channel frame assemblies with welded or mechanical joints. Provide subframes and reinforcement as required for a complete system to support required loads.
2. Perform fabrication operations in manner that prevents damage to exposed finish surfaces.
3. Form profiles that are sharp, straight, and free of defects or deformations.
4. Provide components with concealed fasteners and anchor and connection devices.
5. Fabricate components with accurately fitted joints, with ends coped or mitered to produce hairline joints free of burrs and distortion.
6. Fabricate exterior components to drain water passing joints, condensation occurring within framing members, and moisture migrating within system to exterior. Provide anchorage and alignment brackets for concealed support of assembly from building structure.
7. Allow for thermal expansion of exterior units.

C. Doors: Factory fabricated and assembled in profiles indicated. Reinforce as required to support imposed loads and for installing hardware.

D. Door Operators: Factory fabricated and installed in headers, including adjusting and testing.

E. Glazing: Fabricate framing with minimum glazing edge clearances for thickness and type of glazing indicated, according to GANA's "Glazing Manual."

F. Hardware: Factory install hardware to greatest extent possible; remove only as required for final finishing operation and for delivery to and installation at Project site. Cut, drill, and tap for factory-installed hardware before applying finishes.

1. Provide sliding-type weather stripping, mortised into door, at perimeter of doors and breakaway sidelites.

G. Controls:

1. General: Factory install activation and safety devices in doors and headers as required by BHMA A156.10 for type of door and direction of travel.

2.9 GENERAL FINISH REQUIREMENTS

A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

B. Apply organic and anodic finishes to formed metal after fabrication unless otherwise indicated.

C. Appearance of Finished Work: Noticeable variations in same piece are unacceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.10 ALUMINUM FINISHES

A. Interior Door: Clear Anodic Finish: AAMA 611, AA-M12 C22 A31, Class II, 0.4-0.7 mils thick.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances, header support, and other conditions affecting performance of automatic entrances.

B. Examine roughing-in for electrical systems to verify actual locations of power connections before automatic entrance installation.

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

3.2 INSTALLATION

A. General: Install automatic entrances according to manufacturer's written instructions and cited BHMA A156.10 for direction of pedestrian travel, including signage, controls, wiring, and connection to the building's power supply.

1. Do not install damaged components. Fit frame joints to produce hairline joints free of burrs and distortion. Rigidly secure nonmovement joints. Seal joints watertight.
2. Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer or by applying sealant or tape recommended by manufacturer for this purpose.
3. Where aluminum will contact concrete or masonry, protect against corrosion by painting contact surfaces with bituminous coating.

B. Entrances: Install automatic entrances plumb and true in alignment with established lines and grades without warp or rack of framing members and doors. Anchor securely in place.

1. Install surface-mounted hardware using concealed fasteners to greatest extent possible.
2. Set headers, carrier assemblies, tracks, operating brackets, and guides level and true to location with anchorage for permanent support.
3. Install components to drain water passing joints, condensation occurring within framing members, and moisture migrating within system to exterior.
4. Level recesses for recessed thresholds using nonshrink grout.

C. Door Operators: Connect door operators to electrical power distribution system.

D. Access-Control Devices: Connect access-control devices to access-control system, as specified in Division 28 sections.

E. Controls: Install and adjust activation and safety devices according to manufacturer's written instructions and cited BHMA standard for direction of pedestrian travel. Connect control wiring according to Division 26 sections.

F. Guide Rails: Install rails according to BHMA A156.10, including Appendix A, and manufacturer's written instructions unless otherwise indicated.

G. Glazing: Install glazing as specified in Section 088000 "Glazing."

H. Sealants: Comply with requirements specified in Section 079200 "Joint Sealants" to provide weathertight installation.

1. Set exterior thresholds, framing members and flashings in full sealant bed.

2. Seal perimeter of framing members with sealant.

I. Signage: Apply signage on both sides of each door and breakaway sidelite, as required by cited BHMA standard for direction of pedestrian travel.

J. Wiring within Automatic Entrance Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's written limitations on bending radii. Provide and use lacing bars and distribution spools.

3.3 FIELD QUALITY CONTROL

A. Certified Inspector: Owner will engage a qualified Inspector to test and inspect components, assemblies, and installations, including connections.

B. Perform the following tests and inspections with the assistance of a factory-authorized service representative:

1. Test and inspect each automatic entrance, using AAADM inspection forms, to determine compliance of installed systems with applicable BHMA standards.

C. Automatic entrances will be considered defective if they do not pass tests and inspections.

D. Repair or remove and replace installations where inspections indicate that they do not comply with specified requirements.

E. Reinspect repaired or replaced installations to determine if replaced or repaired assemblies comply with specified requirements.

F. Prepare test and inspection reports.

3.4 ADJUSTING

A. Adjust hardware, moving parts, door operators, and controls to function smoothly, and lubricate as recommended by manufacturer; comply with requirements of applicable BHMA standards.

1. Adjust exterior doors for tight closure.

B. Readjust door operators and controls after repeated operation of completed installation equivalent to three days' use by normal traffic (100 to 300 cycles).

3.5 CLEANING

A. Clean glass and metal surfaces promptly after installation. Remove excess glazing and sealant compounds, dirt, and other substances. Repair damaged finish to match original finish.

1. Comply with requirements in Section 088000 "Glazing" for cleaning and maintaining glass.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, repair, and maintain automatic entrances.

END OF SECTION 084229

SECTION 084500 - INSULATED TRANSLUCENT SANDWICH PANEL ASSEMBLIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Insulated translucent panel assemblies, hurricane-resistant.

B. Related Sections:

1. Section 076200 - Sheet Metal Flashing and Trim.
2. Section 079200 - Joint Sealants.
3. Section 133419 - Metal Building Systems.

1.2 SUBMITTALS

A. Delegated-Design Submittal: For installed products indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

B. Product Data:

1. Manufacturer's product data, including construction details, material descriptions, profiles and finishes of skylight components, and manufacturer's installation instructions.
2. Sample Warranty: Provide manufacturers warranty indicating conformance with the specified warranty requirements of this section.

C. Shop Drawings:

1. Indicate size, material, and finish. Show locations and installation procedures.
2. Include details of joints, dimensions, and attachment to adjacent construction.

D. Structural Calculations: Structural analysis data and calculations signed and sealed by a professional engineer licensed in the State of Texas responsible for their preparation to certify conformance with project specific design loads and governing code requirements as described herein and indicated on the drawings.

E. Installer Qualifications: signed by erector, certifying compliance with project qualification requirements.

F. Product Test Reports: For each fiberglass-sandwich-panel assembly, for tests performed by a qualified testing agency.

G. Evaluation Reports: For fiberglass-sandwich-panel assemblies from ICC-ES.

H. Field quality-control reports.

I. Sample Warranties: For special warranties.

J. Maintenance Data: For panel assemblies to include in maintenance manuals.

1.3 QUALITY ASSURANCE

A. Manufacturer's Qualifications:

1. Specialized in manufacturing translucent panel assemblies of type specified with minimum ten (10) consecutive years experience. Show evidence of materials specified being satisfactorily used on at least three (3) projects of similar size and type.

B. Erector's Qualifications:

1. Specialized in installing translucent panel assemblies of type specified with minimum five (5) consecutive years experience and show evidence of satisfactory completion of projects of similar size, scope, and type.

C. Preinstallation Conference:

1. Approximately 7 days before commencement of work, meet a Project site. Include representatives of manufacturer and installer.
2. In addition, notify Architect for observation of fasteners when fasteners are in place, but prior to covering such fasteners with flashings or closures.

1.4 PRODUCT HANDLING

A. Pre-assemble and seal panel units at the factory. Deliver translucent panel assemblies to the job site in rugged shipping units ready for erection.

B. Storage, Handling and Protection:

1. Store panel units on the long edge, on blocking or dunnage, several inches above the ground, blocked and under cover to prevent warping
2. Store, handle and protect materials in accordance with manufacturer's instructions.

1.5 PROJECT CONDITIONS

A. Field Measurements: Verify actual measurements and openings by field measurements before fabrication. Show recorded measurements on shop drawings. Coordinate field measurements and fabrication schedule with construction progress to avoid construction delays.

B. When practical, take accurate field measurements before preparation of shop drawings and fabrication, so as to not delay job progress. Work from dimensions verified in field.

1.6 WARRANTY

A. Manufacturer's Warranty: Warrant the work specified herein against becoming unserviceable, causing an objectionable appearance resulting from either defective or non-conforming materials and workmanship, or failure to perform as required.

1. System Warranty: Defects are defined to include uncontrolled leakage of water, abnormal aging or deterioration, loss of structural integrity of panel assembly or face sheet, or delamination of face sheet from core.
   a. Warranty period: 5 years from date of Substantial Completion

2. Translucent Facing Material Warranty (Polycarbonate and Fiberglass as applicable): Defects are defined to include fiberbloom (fiber exposure), delamination of coating from exterior sheet, abnormal cracking, abnormal aging, more than 8.0 Delta E units of discoloration, or loss of light transmission greater than 6 percent, as described herein.
   a. Warranty period: 10 years non-pro rata from date of Substantial Completion

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design insulated translucent sandwich panel assemblies.

B. Structural Loads: As indicated on Drawings.

C. Deflection Limits:

1. Vertical Panel Assemblies: Limited to 1/60 of clear span for each assembly component.

D. Structural-Test Performance: Provide panel assemblies tested according to ASTM E330, as follows:

1. When tested at positive and negative wind-load design pressures, assemblies do not show evidence of deflection exceeding specified limits.
2. When tested at 150 percent of positive and negative wind-load design pressures, assemblies, including anchorage, do not show evidence of material failures, structural distress, and permanent deformation of main framing members exceeding 0.2 percent of span.
3. Test Durations: As required by design wind velocity, but not less than 10 seconds.

E. Windborne-Debris Impact Resistance: Passes ASTM E1886 missile-impact and cyclic-pressure tests in accordance with ASTM E1996 for Wind Zone indicated.

1. Large-Missile Test: For glazing located within 30 feet of grade.
2. Small-Missile Test: For glazing located between 30 feet and 60 feet above grade.

F. Water Penetration under Static Pressure: Provide panel assemblies that do not evidence water penetration through fixed glazing and framing areas when tested according to ASTM E331 at a minimum static-air-pressure difference of 20 percent of positive wind-load design pressure, but not less than 15 lbf/sq. ft..

G. Thermal Movements: Allow for thermal movements from ambient- and surface-temperature changes. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

H. Energy Performance: Provide panel assemblies with performance properties specified, as indicated in manufacturer's published test data, based on procedures indicated below:

1. Thermal Transmittance (U-Factor): Fixed glazing and framing areas shall have U-factor of not more than 0.53 Btu/sq. ft. x h x deg F as determined according to NFRC 100.
2. Solar Heat Gain Coefficient (SHGC): Fixed glazing and framing areas shall have a SHGC of no greater than 0.27 as determined according to NFRC 200.

3. Air Infiltration: Maximum air leakage through fixed glazing and framing areas of 0.01 cfm/sq. ft. of fixed wall area as determined according to ASTM E283 at a minimum static-air-pressure differential of 6.24 lbf/sq. ft..

2.2 INSULATED TRANSLUCENT SANDWICH-PANEL ASSEMBLIES

A. Insulated Translucent Sandwich Panel Assemblies: Hurricane-resistant, translucent assemblies that are supported by aluminum framing and glazed with fiberglass-sandwich panels.

B. Manufacturers: Subject to compliance with requirements, provide hurricane-resistant insulated translucent sandwich panel assemblies manufactured by one of the following:

1. Kalwall Corporation
2. Major Industries

2.3 FIBERGLASS-SANDWICH PANELS

A. Fiberglass-Sandwich Panels: Uniformly colored, translucent, thermoset, fiberglass-reinforced-polymer face sheets bonded to both sides of a grid core.

B. Panel Thickness: 2-3/4 inches.

C. Grid Core: Mechanically interlocked, extruded-aluminum I-beams, with a minimum flange width of 7/16 inch.

1. Extruded Aluminum: ASTM B221, in alloy and temper recommended in writing by manufacturer.
2. I-Beam Construction: Thermally broken, extruded aluminum.
3. Grid Pattern: Inline rectangle, nominal 12 by 24 inches.

D. Exterior Face Sheet:

1. Thickness: 0.070 inch.
2. Color: Crystal.
3. Protective Weathering Surface: Integral, embedded-glass erosion barrier.

E. Interior Face Sheet:

1. Thickness: 0.045 inch.

F. Fiberglass-Sandwich-Panel Adhesive: Manufacturer's standard for permanent adhesion of facings to cores.

G. Panel Performance:

1. Self-Ignition Temperature: 650 deg F or more according to ASTM D1929.
2. Smoke-Developed Index: 450 or less according to ASTM E84, or 75 or less according to ASTM D2843.
3. Combustibility Classification: Class CC1 based on testing according to ASTM D635.
4. Interior Finish Classification: Class A based on testing according to ASTM E84.
5. Color Change: Not more than 3.0 units Delta E, when measured according to ASTM D2244, after outdoor weathering compliant with procedures in ASTM D1435.
   a. Outdoor Weathering Conditions: Sixty months in southern Florida.
6. Impact Resistance: No fracture or tear at impact of 60 ft. x lbf by a 3-1/4-inch diameter, 5-lb freefalling ball according to UL 972 test procedure.
7. Haze Factor: Greater than 90 percent when tested according to ASTM D1003.

2.4 ALUMINUM FRAMING SYSTEMS

A. Components: Manufacturer's standard extruded-aluminum members of thickness required and reinforced as required to support imposed loads.

1. Construction: Thermally broken, extruded aluminum.

B. Aluminum: Alloy and temper recommended in writing by manufacturer for type of use and finish indicated.

1. Sheet and Plate: ASTM B209.
2. Extruded Bars, Rods, Profiles, and Tubes: ASTM B221.
3. Extruded Structural Pipe and Tubes: ASTM B429.
4. Structural Profiles: ASTM B308.

C. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning skylight components.

D. Fasteners and Accessories: Manufacturer's standard, corrosion-resistant, nonstaining, and nonbleeding fasteners and accessories; compatible with adjacent materials.

1. At closures, retaining caps, or battens, use ASTM A193, 300 series stainless-steel screws.
2. Use self-locking devices where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration.
3. At movement joints, use slip-joint linings, spacers, and sleeves of material and type recommended in writing by manufacturer.

E. Concrete and Masonry Inserts: Hot-dip galvanized cast-iron, malleable-iron, or steel inserts complying with ASTM A123 or ASTM A153requirements.

F. Anchor Bolts: ASTM A307, Grade A, galvanized steel.

G. Other materials, components: As required for a complete watertight and airtight installation as instructed by manufacturer.

H. Flashing: Refer to Section 076200 - Sheet Metal Flashing and Trim, except sill flashing as provided pre-finished by translucent panel assembly manufacturer shall be aluminum.

I. Sealants: Refer to Section 079200 - Joint Sealants.

2.5 FABRICATION

A. Frame System Fabrication:

1. Fabricate components that, when assembled, have the following characteristics:
   a. Profiles that are sharp, straight, and free of defects or deformations.
   b. Accurately fitted joints with ends coped or mitered.
   c. Internal guttering systems or other means to drain water passing through joints, and moisture migrating within assembly to exterior.
2. Fabricate sill closures with weep holes and for installation as continuous component.
3. Reinforce components as required to receive fastener threads.

B. Panel Fabrication: Factory assemble and seal panels.

1. Laminate face sheets to grid core under a controlled process using heat and pressure to produce straight adhesive bonding lines that cover width of core members and that have sharp edges.
   a. White spots indicating lack of bond at intersections of grid-core members are limited in number to four for every 40 sq. ft. of panel and limited in diameter to 3/64 inch.
2. Fabricate with grid pattern that is symmetrical about centerlines of each panel.
3. Fabricate panel to allow condensation within panel to escape.
4. Reinforce panel corners.

2.6 ALUMINUM FINISHES

A. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm or thicker.

PART 3 - EXECUTION

3.1 EXAMINATION

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

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

3.2 INSTALLATION

A. General: Comply with manufacturer's written instructions.

1. Do not install damaged components.
2. Fit joints between aluminum components to produce hairline joints free of burrs and distortion.
3. Rigidly secure nonmovement joints.
4. Install anchors with separators and isolators to prevent metal corrosion, electrolytic deterioration, and immobilization of moving joints.
5. Seal joints watertight unless otherwise indicated.

B. Metal Protection: Where aluminum components will contact dissimilar materials, protect against galvanic action by painting contact surfaces with corrosion-resistant coating or by installing nonconductive spacers as recommended in writing by manufacturer for this purpose.

C. Install components plumb and true in alignment with established lines and elevations.

D. Erection Tolerances: Install panel assemblies to comply with the following maximum tolerances:

1. Alignment: Limit offset from true alignment to 1/32 inch where surfaces abut in line, edge to edge, at corners, or where a reveal or protruding element separates aligned surfaces by less than 3 inches; otherwise, limit offset to 1/8 inch.
2. Location and Plane: Limit variation from true location and plane to 1/8 inch in 12 feet, but no greater than 1/2 inch over total length.

3.3 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

1. Water-Spray Test: Before installation of interior finishes has begun, panel assemblies shall be tested according to AAMA 501.2 and shall not show evidence of water penetration.

B. Repair or remove work where test results and inspections indicate that it does not comply with specified requirements.

C. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

D. Prepare test and inspection reports.

3.4 CLEANING AND PROTECTION

A. Clean systems inside and outside, immediately after installation, according to manufacturer¢s instructions.

B. Protect systems from damage caused by other trades during construction. Repair or replace work damaged during construction.

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 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes:

1. Mechanical and electrified door hardware for:
   a. Swinging doors.
2. Electronic access control system components, including:
   a. Electronic access control devices.
3. The intent of the hardware specification is to specify the hardware for interior and exterior doors, and to establish a type, continuity, and standard of quality. However, it is the door hardware supplier's responsibility to thoroughly review existing conditions, schedules, specifications, drawings, and other Contract Documents to verify the suitability of the hardware specified.

B. Exclusions: Unless specifically listed in hardware sets, hardware is not specified in this section for:

1. Windows
2. Cabinets (casework), including locks in cabinets
3. Signage
4. Toilet accessories
5. Overhead doors

C. Related Sections:

1. Division 07 Section "Joint Sealants" for sealant requirements applicable to threshold installation specified in this section.
2. Division 26 sections for connections to electrical power system and for low-voltage wiring.
3. Division 28 sections for coordination with other components of electronic access control system.

1.3 REFERENCES

A. UL - Underwriters Laboratories

1. UL 10B - Fire Test of Door Assemblies
2. UL 10C - Positive Pressure Test of Fire Door Assemblies
3. UL 1784 - Air Leakage Tests of Door Assemblies
4. UL 305 - Panic Hardware

B. DHI - Door and Hardware Institute

1. Sequence and Format for the Hardware Schedule
2. Recommended Locations for Builders Hardware

3. Key Systems and Nomenclature

C. ANSI - American National Standards Institute

1. ANSI/BHMA A156.1 - A156.29, and ANSI/BHMA A156.31 - Standards for Hardware and Specialties

1.4 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: Technical product data for each item of door hardware, installation instructions, maintenance of operating parts and finish, and other information necessary to show compliance with requirements.
2. Riser and Wiring Diagrams: After final approval of hardware schedule, submit details of electrified door hardware, indicating:
   a. Wiring Diagrams: For power, signal, and control wiring and including:
      1) Details of interface of electrified door hardware and building safety and security systems.
      2) Schematic diagram of systems that interface with electrified door hardware.
      3) Point-to-point wiring.
      4) Risers.

3. Samples for Verification: If requested by Architect, submit production sample of requested door hardware unit in finish indicated, and tagged with full description for coordination with schedule.
   a. Samples will be returned to supplier. Units that are acceptable to Architect may, after final check of operations, be incorporated into Work, within limitations of key coordination requirements.

4. Door Hardware Schedule: Submit schedule with hardware sets in vertical format as illustrated by Sequence of Format for the Hardware Schedule as published by the Door and Hardware Institute. Indicate complete designations of each item required for each door or opening, include:
   a. Door Index; include door number, heading number, and Architects hardware set number.
   b. Opening Lock Function Spreadsheet: List locking device and function for each opening.
   c. Quantity, type, style, function, size, and finish of each hardware item.
   d. Name and manufacturer of each item.
   e. Fastenings and other pertinent information.
   f. Location of each hardware set cross-referenced to indications on Drawings.
   g. Explanation of all abbreviations, symbols, and codes contained in schedule.
   h. Mounting locations for hardware.
   i. Door and frame sizes and materials.
   j. Name and phone number for local manufacturer's representative for each product.

k. Operational Description of openings with any electrified hardware (locks, exits, electromagnetic locks, electric strikes, automatic operators, door position switches, magnetic holders or closer/holder units, and access control components). Operational description should include operational descriptions for: egress, ingress (access), and fire/smoke alarm connections.
   1) Submittal Sequence: Submit door hardware schedule concurrent with submissions of Product Data, Samples, and Shop Drawings. Coordinate submission of door hardware schedule with scheduling requirements of other work to facilitate fabrication of other work that is critical in Project construction schedule.

5. Key Schedule:
   a. After Keying Conference, provide keying schedule listing levels of keying as well as explanation of key system's function, key symbols used and door numbers controlled.
   b. Use ANSI/BHMA A156.28 “Recommended Practices for Keying Systems” as guideline for nomenclature, definitions, and approach for selecting optimal keying system.
   c. Provide 3 copies of keying schedule for review prepared and detailed in accordance with referenced DHI publication. Include schematic keying diagram and index each key to unique door designations.
   d. Index keying schedule by door number, keyset, hardware heading number, cross keying instructions, and special key stamping instructions.
   e. Provide one complete bitting list of key cuts and one key system schematic illustrating system usage and expansion.
      1) Forward bitting list, key cuts and key system schematic directly to Owner, by means as directed by Owner.
   f. Prepare key schedule by or under supervision of supplier, detailing Owner’s final keying instructions for locks.

6. Templates: After final approval of hardware schedule, provide templates for doors, frames and other work specified to be factory or shop prepared for door hardware installation.

C. Informational Submittals:

1. Qualification Data: For Supplier, Installer and Architectural Hardware Consultant.
2. Product data for electrified door hardware:
   a. Certify that door hardware approved for use on types and sizes of labeled fire-rated doors complies with listed fire-rated door assemblies.

3. Warranty: Special warranty specified in this Section.

D. Closeout Submittals:

1. Operations and Maintenance Data: Provide in accordance with Division 01 and include:
   a. Complete information on care, maintenance, and adjustment; data on repair and replacement parts, and information on preservation of finishes.
   b. Catalog pages for each product.
   c. Factory order acknowledgement numbers (for warranty and service)
   d. Name, address, and phone number of local representative for each manufacturer.
   e. Parts list for each product.
   f. Final approved hardware schedule, edited to reflect conditions as-installed.
   g. Final keying schedule
   h. Copies of floor plans with keying nomenclature
   i. As-installed wiring diagrams for each opening connected to power, both low voltage and 110 volts.

j. Copy of warranties including appropriate reference numbers for manufacturers to identify project.

1.5 QUALITY ASSURANCE

A. Supplier Qualifications and Responsibilities: Recognized architectural hardware supplier with record of successful in-service performance for supplying door hardware similar in quantity, type, and quality to that indicated for this Project and that provides certified Architectural Hardware Consultant (AHC) or Door Hardware Consultant (DHC) available to Owner, Architect, and Contractor, at reasonable times during the Work for consultation.

1. Warehousing Facilities: In Project's vicinity.
2. Scheduling Responsibility: Preparation of door hardware and keying schedules.
3. Engineering Responsibility: Preparation of data for electrified door hardware, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in assemblies similar to those indicated for this Project.
4. Coordination Responsibility: Assist in coordinating installation of electronic security hardware with Architect and electrical engineers and provide installation and technical data to Architect and other related subcontractors.
   a. Upon completion of electronic security hardware installation, inspect and verify that all components are working properly.

B. Architectural Hardware Consultant Qualifications: Person who is experienced in providing consulting services for door hardware installations that are comparable in material, design, and extent to that indicated for this Project and meets these requirements:

1. For door hardware, DHI-certified, Architectural Hardware Consultant (AHC) or Door Hardware Consultant (DHC).
2. Can provide installation and technical data to Architect and other related subcontractors.
3. Can inspect and verify components are in working order upon completion of installation.
4. Capable of producing wiring diagrams.
5. Capable of coordinating installation of electrified hardware with Architect and electrical engineers.

C. Single Source Responsibility: Obtain each type of door hardware from single manufacturer.

D. Fire-Rated Door Openings: Provide door hardware for fire-rated openings that complies with NFPA 80 and requirements of authorities having jurisdiction. Provide only items of door hardware that are listed products tested by Underwriters Laboratories, Intertek Testing Services, or other testing and inspecting organizations acceptable to authorities having jurisdiction for use on types and sizes of doors indicated, based on testing at positive pressure and according to NFPA 252 or UL 10C and in compliance with requirements of fire-rated door and door frame labels.

E. Electrified Door Hardware: Listed and labeled as defined in NFPA 70, Article 100, by testing agency acceptable to authorities having jurisdiction.

F. Accessibility Requirements: For door hardware on doors in an accessible route, comply with governing accessibility regulations cited in “REFERENCES” article, herein.

G. Keying Conference

1. Incorporate keying conference decisions into final keying schedule after reviewing door hardware keying system including:
   a. Function of building, flow of traffic, purpose of each area, degree of security required, and plans for future expansion.

b. Preliminary key system schematic diagram.
c. Requirements for key control system.
d. Requirements for access control.
e. Address for delivery of keys.

H. Pre-installation Conference

1. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
2. Inspect and discuss preparatory work performed by other trades.
3. Inspect and discuss electrical roughing-in for electrified door hardware.
4. Review sequence of operation for each type of electrified door hardware.
5. Review required testing, inspecting, and certifying procedures.

I. Coordination Conferences:

1. Installation Coordination Conference: Prior to hardware installation, schedule and hold meeting to review questions or concerns related to proper installation and adjustment of door hardware.
2. 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.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Inventory door hardware on receipt and provide secure lock-up for hardware delivered to Project site.

B. Tag each item or package separately with identification coordinated with final door hardware schedule, and include installation instructions, templates, and necessary fasteners with each item or package.

1. Deliver each article of hardware in manufacturer’s original packaging.

C. Project Conditions:

1. Maintain manufacturer-recommended environmental conditions throughout storage and installation periods.
2. Provide secure lock-up for door hardware delivered to Project. Control handling and installation of hardware items so that completion of Work will not be delayed by hardware losses both before and after installation.

D. Protection and Damage:

1. Promptly replace products damaged during shipping.
2. Handle hardware in manner to avoid damage, marring, or scratching. Correct, replace or repair products damaged during Work.
3. Protect products against malfunction due to paint, solvent, cleanser, or any chemical agent.

E. Deliver keys to manufacturer of key control system for subsequent delivery to Owner.

F. Deliver keys and permanent cores to Owner by registered mail or overnight package service.

1.7 COORDINATION

A. Coordinate layout and installation of floor-recessed door hardware with floor construction. Cast anchoring inserts into concrete.

B. Installation Templates: Distribute for doors, frames, and other work specified to be factory or shop prepared. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.

C. Security: Coordinate installation of door hardware, keying, and access control with Owner's security consultant.

D. Electrical System Roughing-In: Coordinate layout and installation of electrified door hardware with connections to power supplies and building safety and security systems.

1.8 WARRANTY

A. Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of door hardware that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Beginning from date of Substantial Completion, for durations indicated.
   a. Closers:
      1) Mechanical: LCN 4000 series, 30 years
   b. Exit Devices:
      1) Mechanical: 3 years.
      2) Electrified: 1 year.
   c. Locksets:
      1) Mechanical: Schlage ND series, 10 years
      2) Electrified: 1 year.
   d. Continuous Hinges: Lifetime warranty.
   e. Key Blanks: Lifetime

2. Warranty does not cover damage or faulty operation due to improper installation, improper use or abuse.

1.9 MAINTENANCE

A. Maintenance Tools: Furnish complete set of special tools required for maintenance and adjustment of hardware, including changing of cylinders.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. The Owner requires use of certain products for their unique characteristics and project suitability to insure continuity of existing and future performance and maintenance standards. After investigating available product offerings, the Awarding Authority has elected to prepare proprietary specifications. These products are specified with the notation: “No Substitute.”

1. Where “No Substitute” is noted, submittals and substitution requests for other products will not be considered.

B. Approval of manufacturers and/or products other than those listed as “Scheduled Manufacturer” or “Acceptable Manufacturers” in the individual article for the product category shall be in accordance with QUALITY ASSURANCE article, herein.

C. Approval of products from manufacturers indicated in “Acceptable Manufacturers” is contingent upon those products providing all functions and features and meeting all requirements of scheduled manufacturer’s product.

D. Where specified hardware is not adaptable to finished shape or size of members requiring hardware, furnish suitable types having same operation and quality as type specified, subject to Architect's approval.

2.2 MATERIALS

A. Fasteners

1. Provide hardware manufactured to conform to published templates, generally prepared for machine screw installation.
2. Furnish screws for installation with each hardware item. Finish exposed (exposed under any condition) screws to match hardware finish, or, if exposed in surfaces of other work, to match finish of this other work including prepared for paint surfaces to receive painted finish.
3. Provide concealed fasteners for hardware units exposed when door is closed except when no standard units of type specified are available with concealed fasteners. Do not use thru-bolts for installation where bolt head or nut on opposite face is exposed in other work unless thru-bolts are required to fasten hardware securely. Review door specification and advise Architect if thru-bolts are required.
4. Install hardware with fasteners provided by hardware manufacturer.

B. Provide screws, bolts, expansion shields, drop plates and other devices necessary for hardware installation.

1. Where fasteners are exposed to view: Finish to match adjacent door hardware material.

2.3 HINGES

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product: Ives 5BB series.
2. Acceptable Manufacturers and Products: Hager BB series, McKinney TA/T4A series, Stanley FBB Series.

B. Requirements:

1. Provide hinges conforming to ANSI/BHMA A156.1.
2. 1-3/4 inch thick doors, up to and including 36 inches wide:
   a. Exterior: Standard weight, bronze or stainless steel, 4-1/2 inches high
   b. Interior: Standard weight, steel, 4-1/2 inches high
3. 1-3/4 inch thick doors over 36 inches wide:
   a. Exterior: Heavy weight, bronze/stainless steel, 5 inches high
   b. Interior: Heavy weight, steel, 5 inches high
4. 2 inches or thicker doors:
   a. Exterior: Heavy weight, bronze or stainless steel, 5 inches high
   b. Interior: Heavy weight, steel, 5 inches high

5. Provide three hinges per door leaf for doors 90 inches or less in height, and one additional hinge for each 30 inches of additional door height.
6. Where new hinges are specified for existing doors or existing frames, provide new hinges of identical size to hinge preparation present in existing door or existing frame.
7. Hinge Pins: Except as otherwise indicated, provide hinge pins as follows:
   a. Steel Hinges: Steel pins
   b. Non-Ferrous Hinges: Stainless steel pins
   c. Out-Swinging Exterior Doors: Non-removable pins
   d. Out-Swinging Interior Lockable Doors: Non-removable pins
   e. Interior Non-lockable Doors: Non-rising pins
8. Width of hinges: 4-1/2 inches at 1-3/4 inch thick doors, and 5 inches at 2 inches or thicker doors. Adjust hinge width as required for door, frame, and wall conditions to allow proper degree of opening.

2.4 CONTINUOUS HINGES

A. Aluminum Geared

1. Manufacturers:
   a. Scheduled Manufacturer: Ives.
   b. Acceptable Manufacturers: Select, Stanley.
2. Requirements:
   a. Provide aluminum geared continuous hinges conforming to ANSI/BHMA A156.26, Grade 1.
   b. Provide aluminum geared continuous hinges, where specified in the hardware sets, fabricated from 6063-T6 aluminum.
   c. Provide split nylon bearings at each hinge knuckle for quiet, smooth, self-lubricating operation.
   d. Provide hinges capable of supporting door weights up to 450 pounds, and successfully tested for 1,500,000 cycles.
   e. On fire-rated doors, provide aluminum geared continuous hinges that are classified for use on rated doors by testing agency acceptable to authority having jurisdiction.
   f. Provide aluminum geared continuous hinges with electrified option scheduled in the hardware sets. Provide with sufficient number and wire gage to accommodate electric function of specified hardware.
   g. Install hinges with fasteners supplied by manufacturer.
   h. Provide hinges 1 inch shorter in length than nominal height of door, unless otherwise noted or door details require shorter length and with symmetrical hole pattern.

2.5 ELECTRIC POWER TRANSFER

A. Manufacturers:

1. Scheduled Manufacturer: Von Duprin EPT-10.
2. Acceptable Manufacturers: ABH PT1000, Securitron CEPT-10.

B. Provide power transfer with electrified options as scheduled in the hardware sets. Provide with number and gage of wires sufficient to accommodate electric function of specified hardware.

C. Locate electric power transfer per manufacturer’s template and UL requirements, unless interference with operation of door or other hardware items.

2.6 FLUSH BOLTS

A. Manufacturers:

1. Scheduled Manufacturer: Ives.
2. Acceptable Manufacturers: Burns, Rockwood.

B. Requirements:

1. Provide automatic, constant latching, and manual flush bolts with forged bronze or stainless-steel face plates, extruded brass levers, and with wrought brass guides and strikes. Provide 12 inch steel or brass rods at doors up to 90 inches in height. For doors over 90 inches in height increase top rods by 6 inches for each additional 6 inches of door height. Provide dust-proof strikes at each bottom flush bolt.

2.7 CYLINDRICAL LOCKS – GRADE 1

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product: Schlage ND series.
2. Acceptable Manufacturers and Products: Best 9K Series.

B. Requirements:

1. Provide cylindrical locks conforming to ANSI/BHMA A156.2 Series 4000, Grade 1, and UL Listed for 3 hour fire doors.
2. Cylinders: Refer to “KEYING” article, herein.
3. Provide locks with standard 2-3/4 inches backset, unless noted otherwise, with 1/2 inch latch throw. Provide proper latch throw for UL listing at pairs.
4. Provide locksets with separate anti-rotation thru-bolts, and no exposed screws.
5. Provide independently operating levers with two external return spring cassettes mounted under roses to prevent lever sag.
6. Provide standard ASA strikes unless extended lip strikes are necessary to protect trim.
7. Provide electrified options as scheduled in the hardware sets.
8. Lever Trim: Solid cast levers without plastic inserts and wrought roses on both sides.
   a. Lever Design: Schlage Sparta

2.8 AUXILIARY LOCKS

A. Deadbolts:

1. Manufacturers and Products:
   a. Scheduled Manufacturer and Product: Schlage B600 Series.
   b. Acceptable Manufacturers and Products: Best T Series.

2. Requirements:
   a. Provide deadbolt series conforming to ANSI/BHMA A156 and function as specified.
   b. Cylinders: Refer to “KEYING” article, herein.
   c. Provide deadbolts with standard 2-3/4 inches backset. Provide 2-3/8 inches where noted or if door or frame detail requires. Provide deadbolt with full 1 inch throw, constructed of steel alloy.
   d. Provide manufacturer’s standard strike.

2.9 EXIT DEVICES

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product: Von Duprin 99 series.
2. Acceptable Manufacturers and Products: No Substitute.

B. Requirements:

1. Provide exit devices tested to ANSI/BHMA A156.3 Grade 1 and UL listed for Panic Exit or Fire Exit Hardware.
2. Cylinders: Refer to “KEYING” article, herein.
3. Provide touchpad type exit devices, fabricated of brass, bronze, stainless steel, or aluminum, plated to standard architectural finishes to match balance of door hardware.
4. Touchpad must extend a minimum of one half of door width. No plastic inserts are allowed in touchpads.
5. Provide exit devices with deadlatching feature for security and for future addition of alarm kits and/or other electrified requirements.
6. Provide flush end caps for exit devices.
7. Provide exit devices with manufacturer’s approved strikes.
8. Provide exit devices cut to door width and height. Install exit devices at height recommended by exit device manufacturer, allowable by governing building codes, and approved by Architect.
9. Mount mechanism case flush on face of doors, or provide spacers to fill gaps behind devices. Where glass trim or molding projects off face of door, provide glass bead kits.
10. Provide cylinder or hex-key dogging as specified at non fire-rated openings.
11. Removable Mullions: 2 inches x 3 inches steel tube. Where scheduled as keyed removable mullion, provide type that can be removed by use of a keyed cylinder, which is self-locking when re-installed.
12. Provide factory drilled weep holes for exit devices used in full exterior application, highly corrosive areas, and where noted in hardware sets.
13. Provide electrified options as scheduled.
14. Rim Exit Devices: provide devices with non-tapered smart latchbolt with 90° latchbolt to strike engagement under stress and Static Load Resistance of 2000 pounds.
15. Provide exit devices with optional trim designs to match other lever and pull designs used on the project.

2.10 CYLINDERS

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product: Best.
2. Acceptable Manufacturers and Products: No Substitute.

B. Requirements:

1. Provide cylinders/cores compliant with ANSI/BHMA A156.5; latest revision; cylinder face finished to match lockset, manufacturer’s series as indicated. Refer to “KEYING” article, herein.
2. Provide cylinders in the below-listed configuration(s), distributed throughout the Project as indicated.
3. Nickel silver bottom pins.

C. Construction Keying:

1. Replaceable Construction Cores.
   a. Provide temporary construction cores replaceable by permanent cores, furnished in accordance with the following requirements.
      1) 3 construction control keys
      2) 12 construction change (day) keys.

b. Owner or Owner's Representative will replace temporary construction cores with permanent cores.

2.11 KEYING

A. Provide a factory registered keying system, complying with guidelines in ANSI/BHMA A156.28, incorporating decisions made at keying conference.

B. Comply with guidelines in ANSI/BHMA A156.28, incorporating decisions made at keying conference.

C. Requirements:

1. Provide permanent cylinders/cores keyed by the manufacturer according to the following key system.
   a. Master Keying system as directed by the Owner.
2. Forward bitting list and keys separately from cylinders, by means as directed by Owner. Failure to comply with forwarding requirements will be cause for replacement of cylinders/cores involved at no additional cost to Owner.
3. Provide keys with the following features:
   a. Material: Nickel silver; minimum thickness of .107-inch
4. Identification:
   a. Mark permanent cylinders/cores and keys with applicable blind code per DHI publication "Keying Systems and Nomenclature" for identification. Do not provide blind code marks with actual key cuts.
   b. Identification stamping provisions must be approved by the Architect and Owner.
   c. Stamp cylinders/cores and keys with Owner's unique key system facility code as established by the manufacturer; key symbol and embossed or stamped with "DO NOT DUPLICATE" along with the "PATENTED" or patent number to enforce the patent protection.
   d. Failure to comply with stamping requirements will be cause for replacement of keys involved at no additional cost to Owner.
   e. Forward permanent cylinders/cores to Owner, separately from keys, by means as directed by Owner.
5. Quantity: Furnish in the following quantities.
   a. Change (Day) Keys: 3 per cylinder/core.
   b. Permanent Control Keys: 3.
   c. Master Keys: 6.

2.12 KEY CONTROL SYSTEM

A. Manufacturers:

1. Scheduled Manufacturer: Telkee.
2. Acceptable Manufacturers: HPC, Lund.

B. Requirements:

1. Provide key control system, including envelopes, labels, tags with self-locking key clips, receipt forms, 3-way visible card index, temporary markers, permanent markers, and standard metal cabinet, all as recommended by system manufacturer, with capacity for 150% of number of locks required for Project.
   a. Provide complete cross index system set up by hardware supplier, and place keys on markers and hooks in cabinet as determined by final key schedule.

b. Provide hinged-panel type cabinet for wall mounting.

2.13 Key Management Software

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product: Schlage SITEMASTER 200.
2. Acceptable Manufacturers and Products: Best Keystone 600N, Corbin-Russwin KeyWizard, Medeco KeyWizard, Sargent KeyWizard, Yale KeyWizard.

B. Requirements:

1. Software: Provide tracking, issuing, collecting and transferring information regarding keys. Provide customized query, reporting, searching capability, comprehensive location hardware listings, display key holder photos and signature for verification, and provide automatic reminders for maintenance, back-ups and overdue keys.
2. Provide training for Owner's personnel on proper operation and application of key management software.

2.14 DOOR CLOSERS

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product: LCN 4040XP series.
2. Acceptable Manufacturers and Products: No Substitute.

B. Requirements:

1. Provide door closers conforming to ANSI/BHMA A156.4 Grade 1 requirements by BHMA certified independent testing laboratory. ISO 9000 certify closers. Stamp units with date of manufacture code.
2. Provide door closers with fully hydraulic, full rack and pinion action with high strength cast iron cylinder, and full complement bearings at shaft.
3. Cylinder Body: 1-1/2 inch diameter with 5/8 inch diameter double heat-treated pinion journal.
4. Hydraulic Fluid: Fireproof, passing requirements of UL10C, and requiring no seasonal closer adjustment for temperatures ranging from 120 degrees F to -30 degrees F.
5. Spring Power: Continuously adjustable over full range of closer sizes, and providing reduced opening force as required by accessibility codes and standards.
6. Hydraulic Regulation: By tamper-proof, non-critical valves, with separate adjustment for latch speed, general speed, and backcheck.
7. Provide closers with solid forged steel main arms and factory assembled heavy-duty forged forearms for parallel arm closers.
8. Pressure Relief Valve (PRV) Technology: Not permitted.
9. Finish for Closer Cylinders, Arms, Adapter Plates, and Metal Covers: Powder coating finish which has been certified to exceed 100 hours salt spray testing as described in ANSI Standard A156.4 and ASTM B117, or has special rust inhibitor (SRI).
10. Provide special templates, drop plates, mounting brackets, or adapters for arms as required for details, overhead stops, and other door hardware items interfering with closer mounting.

2.15 DOOR TRIM

A. Manufacturers:

1. Scheduled Manufacturer: Ives.

2. Acceptable Manufacturers: Burns, Rockwood.

B. Requirements:

1. Provide push plates 4 inches wide by 16 inches high by 0.050 inch thick and beveled 4 edges. Where width of door stile prevents use of 4 inches wide plate, adjust width to fit.
2. Provide push bars of solid bar stock, diameter and length as scheduled. Provide push bars of sufficient length to span from center to center of each stile. Where required, mount back to back with pull.
3. Provide offset pulls of solid bar stock, diameter and length as scheduled. Where required, mount back to back with push bar.
4. Provide flush pulls as scheduled. Where required, provide back-to-back mounted model.
5. Provide pulls of solid bar stock, diameter and length as scheduled. Where required, mount back to back with push bar.
6. Provide pull plates 4 inches wide by 16 inches high by 0.050 inch thick, beveled 4 edges, and prepped for pull. Where width of door stile prevents use of 4 inches wide plate, adjust width to fit.
7. Provide wire pulls of solid bar stock, diameter and length as scheduled.
8. Provide decorative pulls as scheduled. Where required, mount back to back with pull.

2.16 PROTECTION PLATES

A. Manufacturers:

1. Scheduled Manufacturer: Ives.
2. Acceptable Manufacturers: Burns, Rockwood.

B. Requirements:

1. Provide kick plates, mop plates, and armor plates minimum of 0.050 inch thick, beveled four edges as scheduled. Furnish with sheet metal or wood screws, finished to match plates.
2. Sizes of plates:
   a. Kick Plates: 10 inches high by 2 inches less width of door on single doors, 1 inch less width of door on pairs
   b. Mop Plates: 4 inches high by 2 inches less width of door on single doors, 1 inch less width of door on pairs
   c. Armor Plates: 36 inches high by 2 inches less width of door on single doors, 1 inch less width of door on pairs

2.17 OVERHEAD STOPS AND OVERHEAD STOP/HOLDERS

A. Manufacturers:

1. Scheduled Manufacturers: Glynn-Johnson.
2. Acceptable Manufacturers: Rixson, Sargent.

B. Requirements:

1. Provide heavy duty concealed mounted overhead stop or holder as specified for exterior and interior vestibule single acting doors.
2. Provide heavy duty concealed mounted overhead stop or holder as specified for double acting doors.

3. Provide heavy or medium duty and concealed or surface mounted overhead stop or holder for interior doors as specified. Provide medium duty surface mounted overhead stop for interior doors and at any door that swings more than 140 degrees before striking wall, open against equipment, casework, sidelights, and where conditions do not allow wall stop or floor stop presents tripping hazard.
4. Where overhead holders are specified provide friction type at doors without closer and positive type at doors with closer.

2.18 DOOR STOPS AND HOLDERS

A. Manufacturers:

1. Scheduled Manufacturer: Ives.
2. Acceptable Manufacturers: Burns, Rockwood.

B. Provide door stops at each door leaf:

1. Provide wall stops wherever possible. Provide convex type where mortise type locks are used and concave type where cylindrical type locks are used.
2. Where a wall stop cannot be used, provide universal floor stops for low or high rise options.
3. Where wall or floor stop cannot be used, provide medium duty surface mounted overhead stop.

2.19 THRESHOLDS, SEALS, DOOR SWEEPS, AUTOMATIC DOOR BOTTOMS, AND GASKETING

A. Manufacturers:

1. Scheduled Manufacturer: Zero International.
2. Acceptable Manufacturers: National Guard, Reese.

B. Requirements:

1. Provide thresholds, weather-stripping (including door sweeps, seals, and astragals) and gasketing systems (including smoke, sound, and light) as specified and per architectural details. Match finish of other items.
2. Smoke- and Draft-Control Door Assemblies: Where smoke- and draft-control door assemblies are required, provide door hardware that meets requirements of assemblies tested according to UL 1784 and installed in compliance with NFPA 105.
3. Size of thresholds:
   a. Saddle Thresholds: 1/2 inch high by jamb width by door width
   b. Bumper Seal Thresholds: 1/2 inch high by 5 inches wide by door width
4. Provide door sweeps, seals, astragals, and auto door bottoms only of type where resilient or flexible seal strip is easily replaceable and readily available.

2.20 SILENCERS

A. Manufacturers:

1. Scheduled Manufacturer: Ives.
2. Acceptable Manufacturers: Burns, Rockwood.

B. Requirements:

1. Provide "push-in" type silencers for hollow metal or wood frames.

2. Provide one silencer per 30 inches of height on each single frame, and two for each pair frame.
3. Omit where gasketing is specified.

2.21 FINISHES

A. Finish: BHMA 626/652 (US26D); except:

1. Hinges at Exterior Doors: BHMA 630 (US32D)
2. Continuous Hinges: BHMA 630 (US32D)
3. Continuous Hinges: BHMA 628 (US28)
4. Push Plates, Pulls, and Push Bars: BHMA 630 (US32D)
5. Protection Plates: BHMA 630 (US32D)
6. Overhead Stops and Holders: BHMA 630 (US32D)
7. Door Closers: Powder Coat to Match
8. Wall Stops: BHMA 630 (US32D)
9. Latch Protectors: BHMA 630 (US32D)
10. Weatherstripping: Clear Anodized Aluminum
11. Thresholds: Mill Finish Aluminum

PART 3 - EXECUTION

3.1 EXAMINATION

A. Prior to installation of hardware, examine doors and frames, with Installer present, for compliance with requirements for installation tolerances, labeled fire-rated door assembly construction, wall and floor construction, and other conditions affecting performance.

B. Examine roughing-in for electrical power systems to verify actual locations of wiring connections before electrified door hardware installation.

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

3.2 INSTALLATION

A. Mount door hardware units at heights to comply with the following, unless otherwise indicated or required to comply with governing regulations.

1. Standard Steel Doors and Frames: ANSI/SDI A250.8.
2. Custom Steel Doors and Frames: HMMA 831.
3. Wood Doors: DHI WDHS.3, "Recommended Locations for Architectural Hardware for Wood Flush Doors."

B. Install each hardware item in compliance with manufacturer’s instructions and recommendations, using only fasteners provided by manufacturer.

C. Do not install surface mounted items until finishes have been completed on substrate. Protect all installed hardware during painting.

D. Set units level, plumb and true to line and location. Adjust and reinforce attachment substrate as necessary for proper installation and operation.

E. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.

F. Install operating parts so they move freely and smoothly without binding, sticking, or excessive clearance.

G. Hinges: Install types and in quantities indicated in door hardware schedule but not fewer than quantity recommended by manufacturer for application indicated or one hinge for every 30 inches of door height, whichever is more stringent, unless other equivalent means of support for door, such as spring hinges or pivots, are provided.

H. Intermediate Offset Pivots: Where offset pivots are indicated, provide intermediate offset pivots in quantities indicated in door hardware schedule but not fewer than one intermediate offset pivot per door and one additional intermediate offset pivot for every 30 inches of door height greater than 90 inches.

I. Lock Cylinders: Install construction cores to secure building and areas during construction period.

1. Replace construction cores with permanent cores as indicated in keying section.
2. Furnish permanent cores to Owner for installation.

J. Wiring: Coordinate with Division 26, ELECTRICAL sections for:

1. Conduit, junction boxes and wire pulls.
2. Connections to and from power supplies to electrified hardware.
3. Connections to fire/smoke alarm system and smoke evacuation system.
4. Connection of wire to door position switches and wire runs to central room or area, as directed by Architect.
5. Testing and labeling wires with Architect’s opening number.

K. Key Control System: Tag keys and place them on markers and hooks in key control system cabinet, as determined by final keying schedule.

L. Door Closers: Mount closers on room side of corridor doors, inside of exterior doors, and stair side of stairway doors from corridors. Mount closers so they are not visible in corridors, lobbies and other public spaces unless approved by Architect.

M. Closer/Holders: Mount closer/holders on room side of corridor doors, inside of exterior doors, and stair side of stairway doors.

N. Power Supplies: Locate power supplies as indicated or, if not indicated, above accessible ceilings or in equipment room, or alternate location as directed by Architect.

O. Thresholds: Set thresholds in full bed of sealant complying with requirements specified in Division 07 Section "Joint Sealants."

P. Stops: Provide floor stops for doors unless wall or other type stops are indicated in door hardware schedule. Do not mount floor stops where they may impede traffic or present tripping hazard.

Q. Perimeter Gasketing: Apply to head and jamb, forming seal between door and frame.

R. Meeting Stile Gasketing: Fasten to meeting stiles, forming seal when doors are closed.

S. Door Bottoms: Apply to bottom of door, forming seal with threshold when door is closed.

3.3 FIELD QUALITY CONTROL

A. Engage qualified manufacturer trained representative to perform inspections and to prepare inspection reports.

1. Representative will inspect door hardware and state in each report whether installed work complies with or deviates from requirements, including whether door hardware is properly installed and adjusted.

3.4 ADJUSTING

A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.

1. Door Closers: Adjust sweep period to comply with accessibility requirements and requirements of authorities having jurisdiction.

B. Occupancy Adjustment: Approximately three to six months after date of Substantial Completion, Installer's Architectural Hardware Consultant must examine and readjust each item of door hardware, including adjusting operating forces, as necessary to ensure function of doors and door hardware.

3.5 CLEANING AND PROTECTION

A. Clean adjacent surfaces soiled by door hardware installation.

B. Clean operating items as necessary to restore proper function and finish.

C. Provide final protection and maintain conditions that ensure door hardware is without damage or deterioration at time of Substantial Completion.

3.6 DOOR HARDWARE SCHEDULE

A. Hardware items are referenced in the following hardware. Refer to the above-specifications for special features, options, cylinders/keying, and other requirements.

B. Hardware Sets:

Hardware Group No. 001

Provide each RU door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
1	EA	MORTISE CYLINDER	1E SERIES AS REQ X CONSTR CORE	626	BES
1	EA	SFIC PERMANENT CORE	TYPE AS REQ	626	BES
1	EA	NOTE	REMAINDER OF HARDWARE BY DOOR MANUFACTURER		

-Coordinate hardware with door MFR.

Hardware Group No. 103

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	ENTRANCE LOCK	ND53HD SPA	626	SCH
1	EA	SFIC PERMANENT CORE	TYPE AS REQ	626	BES
1	EA	WALL STOP	WS406/407CCV	630	IVE
1	EA	GASKETING	488S PSA H & J (USE SILENCERS @ NON-RATED DOORS)	BK	ZER

Hardware Group No. 103A

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
1	EA	CONT. HINGE	112XY HEIGHT AS REQ	628	IVE
1	EA	ENTRANCE LOCK	ND53HD SPA	626	SCH
1	EA	SFIC PERMANENT CORE	TYPE AS REQ	626	BES
1	EA	WALL STOP	WS406/407CCV	630	IVE
1	SET	SEAL	PERIMETER SEAL BY FRAME MANUFACTURER		

Hardware Group No. 201

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	STOREROOM LOCK	ND80HD SPA	626	SCH
1	EA	SFIC PERMANENT CORE	TYPE AS REQ	626	BES
1	EA	SURFACE CLOSER	4040XP RW/PA X MTG BRKT, SPCR & PLATE AS REQ	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS406/407CCV	630	IVE
1	EA	GASKETING	488S PSA H & J (USE SILENCERS @ NON-RATED DOORS)	BK	ZER

Hardware Group No. 201C

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	STOREROOM LOCK	ND80HD SPA	626	SCH
1	EA	SFIC PERMANENT CORE	TYPE AS REQ	626	BES
1	EA	SURFACE CLOSER	4040XP SCUSH X MTG BRKT, SPCR & PLATE AS REQ	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	GASKETING	488S PSA H & J (USE SILENCERS @ NON-RATED DOORS)	BK	ZER

Hardware Group No. 201GW

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1HW 5 X 4.5	652	IVE
1	EA	STOREROOM LOCK	ND80HD SPA	626	SCH
1	EA	SFIC PERMANENT CORE	TYPE AS REQ	626	BES
1	EA	SURFACE CLOSER	4040XP RW/PA X MTG BRKT, SPCR & PLATE AS REQ	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS406/407CCV	630	IVE
1	EA	GASKETING	188SBK PSA H & J	BK	ZER
1	EA	GASKETING	488S PSA H & J (USE SILENCERS @ NON-RATED DOORS)	BK	ZER
1	EA	DOOR SWEEP	39A LENGTH AS REQ	A	ZER
1	EA	THRESHOLD	655A LENGTH AS REQ	A	ZER

Hardware Group No. 201W

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1HW 5 X 4.5	652	IVE
1	EA	STOREROOM LOCK	ND80HD SPA	626	SCH
1	EA	SFIC PERMANENT CORE	TYPE AS REQ	626	BES
1	EA	SURFACE CLOSER	4040XP RW/PA X MTG BRKT, SPCR & PLATE AS REQ	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS406/407CCV	630	IVE
1	EA	GASKETING	488S PSA H & J (USE SILENCERS @ NON-RATED DOORS)	BK	ZER

Hardware Group No. 341

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	PRIVACY LOCK	L9040 17A L583-363 L283-722	626	SCH
1	EA	SURFACE CLOSER	4040XP RW/PA X MTG BRKT, SPCR & PLATE AS REQ	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS406/407CCV	630	IVE
1	EA	GASKETING	488S PSA H & J (USE SILENCERS @ NON-RATED DOORS)	BK	ZER

-OCCUPIED/VACANT INDICATOR ON OUTSIDE OF DOOR.

Hardware Group No. 401

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	PASSAGE SET	ND10S SPA	626	SCH
1	EA	SURFACE CLOSER	4040XP RW/PA X MTG BRKT, SPCR & PLATE AS REQ	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS406/407CCV	630	IVE
1	EA	GASKETING	488S PSA H & J (USE SILENCERS @ NON-RATED DOORS)	BK	ZER

Hardware Group No. 403

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	PASSAGE SET	ND10S SPA	626	SCH
1	EA	WALL STOP	WS406/407CCV	630	IVE
1	EA	GASKETING	488S PSA H & J (USE SILENCERS @ NON-RATED DOORS)	BK	ZER

Hardware Group No. 501

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	CLASSROOM LOCK	ND70HD SPA	626	SCH
1	EA	SFIC PERMANENT CORE	TYPE AS REQ	626	BES
1	EA	SURFACE CLOSER	4040XP RW/PA X MTG BRKT, SPCR & PLATE AS REQ	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS406/407CCV	630	IVE
1	EA	GASKETING	488S PSA H & J (USE SILENCERS @ NON-RATED DOORS)	BK	ZER

Hardware Group No. 501ACG

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
1	EA	CONT. HINGE	112XY HEIGHT AS REQ	628	IVE
1	EA	CLASSROOM LOCK	ND70HD SPA	626	SCH
1	EA	SFIC PERMANENT CORE	TYPE AS REQ	626	BES
1	EA	SURFACE CLOSER	4040XP SCUSH X MTG BRKT, SPCR & PLATE AS REQ	689	LCN
1	SET	SEAL	PERIMETER SEAL BY FRAME MANUFACTURER		
1	EA	DOOR SWEEP	39A LENGTH AS REQ	A	ZER
1	EA	THRESHOLD	655A LENGTH AS REQ	A	ZER

Hardware Group No. 507

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	CLASSROOM LOCK	ND70HD SPA	626	SCH
1	EA	SFIC PERMANENT CORE	TYPE AS REQ	626	BES
1	EA	OH STOP	900S SERIES X SIZE & MOUNTING AS REQ	630	GLY
1	EA	SURFACE CLOSER	4040XP RW/PA X MTG BRKT, SPCR & PLATE AS REQ	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	GASKETING	488S PSA H & J (USE SILENCERS @ NON-RATED DOORS)	BK	ZER

Hardware Group No. 701

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1HW 4.5 X 4.5	652	IVE
1	EA	PANIC HARDWARE	99-L-17 LENGTH AS REQ	626	VON
1	EA	RIM CYLINDER	12E SERIES AS REQ X CONSTR CORE	626	BES
1	EA	SFIC PERMANENT CORE	TYPE AS REQ	626	BES
1	EA	SURFACE CLOSER	4040XP RW/PA X MTG BRKT, SPCR & PLATE AS REQ	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS406/407CCV	630	IVE
1	EA	GASKETING	488S PSA H & J (USE SILENCERS @ NON-RATED DOORS)	BK	ZER

Hardware Group No. 705AG

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
1	EA	CONT. HINGE	112XY HEIGHT AS REQ	628	IVE
1	EA	PANIC HARDWARE	99-L-17 LENGTH AS REQ	626	VON
1	EA	RIM CYLINDER	12E SERIES AS REQ X CONSTR CORE	626	BES
1	EA	SFIC PERMANENT CORE	TYPE AS REQ	626	BES
1	EA	SURFACE CLOSER	4040XP RW/PA X MTG BRKT, SPCR & PLATE AS REQ	689	LCN
1	EA	WALL STOP	WS406/407CCV	630	IVE
1	SET	SEAL	PERIMETER SEAL BY FRAME MANUFACTURER		
1	EA	DOOR SWEEP	8192AA LENGTH AS REQ	AA	ZER
1	EA	THRESHOLD	655A LENGTH AS REQ	A	ZER

Hardware Group No. 801

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1HW 4.5 X 4.5	652	IVE
1	EA	PUSH PLATE	8200 4" X 16"	630	IVE
1	EA	PULL PLATE	8303 10" 4" X 16"	630	IVE
1	EA	SURFACE CLOSER	4040XP RW/PA X MTG BRKT, SPCR & PLATE AS REQ	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS406/407CCV	630	IVE
3	EA	SILENCER	SR64	GRY	IVE

Hardware Group No. 801L

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1HW 4.5 X 4.5	652	IVE
1	EA	CLASSROOM DEADBOLT	B663HD	626	SCH
1	EA	SFIC PERMANENT CORE	TYPE AS REQ	626	BES
1	EA	PUSH PLATE	8200 4" X 16"	630	IVE
1	EA	PULL PLATE	8303 10" 4" X 16"	630	IVE
1	EA	SURFACE CLOSER	4040XP RW/PA X MTG BRKT, SPCR & PLATE AS REQ	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS406/407CCV	630	IVE
3	EA	SILENCER	SR64	GRY	IVE

Hardware Group No. CW205Q

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1HW 5 X 4.5 NRP	630	IVE
1	EA	POWER TRANSFER	EPT10	689	VON
1	EA	EU STOREROOM LOCK	ND80HDEU SPA RX 12V/24V DC	626	SCH
1	EA	SFIC PERMANENT CORE	TYPE AS REQ	626	BES
1	EA	LOCK GUARD	LG1	630	IVE
1	EA	SURFACE CLOSER	4040XP SCUSH X MTG BRKT, SPCR & PLATE AS REQ	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	RAIN DRIP	142A DW + 4"	AA	ZER
1	EA	GASKETING	188SBK PSA H & J	BK	ZER
1	EA	DOOR SWEEP	39A LENGTH AS REQ	A	ZER
1	EA	THRESHOLD	65A LENGTH AS REQ	A	ZER
1	EA	CARD READER	BY SECURITY PROVIDER		
1	EA	DOOR CONTACT	BY SECURITY PROVIDER		
1	EA	POWER SUPPLY	BY SECURITY CONTRACTOR		

-VERIFY TDI WINDSTORM "CERTIFICATION" OF SPECIFIED HARDWARE W/DOOR SYSTEM. HARDWARE BUILT AS BASIS-OF-DESIGN AROUND STEELCRAFT DOOR SYSTEM.

-INGRESS BY THE CARD READER OR KEY OVERRIDE. FREE EGRESS BY LEVER

Hardware Group No. CW205W

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1HW 5 X 4.5 NRP	630	IVE
1	EA	POWER TRANSFER	EPT10	689	VON
1	EA	EU STOREROOM LOCK	ND80HDEU SPA RX 12V/24V DC	626	SCH
1	EA	SFIC PERMANENT CORE	TYPE AS REQ	626	BES
1	EA	SURFACE CLOSER	4040XP SCUSH X MTG BRKT, SPCR & PLATE AS REQ	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	RAIN DRIP	142A DW + 4"	AA	ZER
1	EA	GASKETING	188SBK PSA H & J	BK	ZER
1	EA	DOOR SWEEP	39A LENGTH AS REQ	A	ZER
1	EA	THRESHOLD	65A LENGTH AS REQ	A	ZER
1	EA	CARD READER	BY SECURITY PROVIDER		
1	EA	DOOR CONTACT	BY SECURITY PROVIDER		
1	EA	POWER SUPPLY	BY SECURITY CONTRACTOR		

-VERIFY TDI WINDSTORM "CERTIFICATION" OF SPECIFIED HARDWARE W/DOOR SYSTEM. HARDWARE BUILT AS BASIS-OF-DESIGN AROUND STEELCRAFT DOOR SYSTEM.

-INGRESS BY THE CARD READER OR KEY OVERRIDE. FREE EGRESS BY LEVER

Hardware Group No. CW714AM

Provide each PR door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
2	SET	PIVOTS	TOP/BOTTOM/INTERMEDIATE AS REQ		KAW
2	EA	POWER TRANSFER	EPT10	689	VON
1	EA	FIRE RATED REMOVABLE MULLION	KR9954 HEIGHT AS REQ	689	VON
1	EA	ELEC PANIC HARDWARE	RX-QEL-XP99-EO LENGTH AS REQ	626	VON
1	EA	ELEC PANIC HARDWARE	RX-QEL-XP99-NL-OP LENGTH AS REQ	626	VON
1	EA	RIM CYLINDER	12E SERIES AS REQ X CONSTR CORE	626	BES
1	EA	MORTISE CYLINDER	1E SERIES AS REQ X CONSTR CORE	626	BES
2	EA	SFIC PERMANENT CORE	TYPE AS REQ	626	BES
2	EA	90 DEG OFFSET PULL	8190-O 10"	630	IVE
2	EA	SURFACE CLOSER	4040XP SCUSH X MTG BRKT, SPCR & PLATE AS REQ	689	LCN
1	SET	SEAL	PERIMETER SEAL BY FRAME MANUFACTURER		
1	SET	ASTRAGAL	MEETING STILE SEAL BY DOOR MANUFACTURER		
2	EA	DOOR SWEEP	APPROVED FOR USE WITH OPENING SYSTEM	A	ZER
1	EA	HD THRESHOLD	APPROVED FOR USE WITH OPENING SYSTEM	A	ZER
1	EA	CARD READER	BY SECURITY PROVIDER		
2	EA	DOOR CONTACT	BY SECURITY PROVIDER		
1	EA	POWER SUPPLY	BY SECURITY CONTRACTOR		

-VERIFY TDI WINDSTORM "CERTIFICATION" OF SPECIFIED HARDWARE W/DOOR SYSTEM. HARDWARE BUILT AS BASIS-OF-DESIGN AROUND STEELCRAFT DOOR SYSTEM.

-INGRESS BY THE CARD READER OR KEY OVERRIDE. FREE EGRESS BY PUSHPAD.

Hardware Group No. CW715

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1HW 4.5 X 4.5 NRP	630	IVE
1	EA	POWER TRANSFER	EPT10	689	VON
1	EA	ELEC PANIC HARDWARE	RX-QEL-99-NL LENGTH AS REQ	626	VON
1	EA	RIM CYLINDER	12E SERIES AS REQ X CONSTR CORE	626	BES
1	EA	SFIC PERMANENT CORE	TYPE AS REQ	626	BES
1	EA	SURFACE CLOSER	4040XP SCUSH X MTG BRKT, SPCR & PLATE AS REQ	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	RAIN DRIP	142A DW + 4"	AA	ZER
1	EA	GASKETING	188SBK PSA H & J	BK	ZER
1	EA	DOOR SWEEP	39A LENGTH AS REQ	A	ZER
1	EA	THRESHOLD	65A LENGTH AS REQ	A	ZER
1	EA	CARD READER	BY SECURITY PROVIDER		
1	EA	DOOR CONTACT	BY SECURITY PROVIDER		
1	EA	POWER SUPPLY	BY SECURITY PROVIDER		

-VERIFY TDI WINDSTORM "CERTIFICATION" OF SPECIFIED HARDWARE W/DOOR SYSTEM. HARDWARE BUILT AS BASIS-OF-DESIGN AROUND STEELCRAFT DOOR SYSTEM.

-INGRESS BY THE KEYPAD READER OR KEY OVERRIDE. FREE EGRESS BY PUSHPAD.

Hardware Group No. CW715A

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
1	SET	PIVOTS	TOP/BOTTOM/INTERMEDIATE AS REQ		KAW
1	EA	POWER TRANSFER	EPT10	689	VON
1	EA	ELEC PANIC HARDWARE	RX-QEL-XP99-NL-OP LENGTH AS REQ	626	VON
1	EA	RIM CYLINDER	12E SERIES AS REQ X CONSTR CORE	626	BES
1	EA	SFIC PERMANENT CORE	TYPE AS REQ	626	BES
1	EA	90 DEG OFFSET PULL	8190-O 10"	630	IVE
1	EA	SURFACE CLOSER	4040XP SCUSH X MTG BRKT, SPCR & PLATE AS REQ	689	LCN
1	SET	SEAL	PERIMETER SEAL BY FRAME MANUFACTURER		
1	EA	DOOR SWEEP	APPROVED FOR USE WITH OPENING SYSTEM	A	ZER
1	EA	HD THRESHOLD	APPROVED FOR USE WITH OPENING SYSTEM	A	ZER
1	EA	CARD READER	BY SECURITY PROVIDER		
1	EA	DOOR CONTACT	BY SECURITY PROVIDER		
1	EA	POWER SUPPLY	BY SECURITY PROVIDER		

-VERIFY TDI WINDSTORM "CERTIFICATION" OF SPECIFIED HARDWARE W/DOOR SYSTEM. HARDWARE BUILT AS BASIS-OF-DESIGN AROUND STEELCRAFT DOOR SYSTEM.

-INGRESS BY THE CARD READER OR KEY OVERRIDE. FREE EGRESS BY PUSHPAD

Hardware Group No. CW715Q

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1HW 4.5 X 4.5 NRP	630	IVE
1	EA	POWER TRANSFER	EPT10	689	VON
1	EA	ELEC PANIC HARDWARE	RX-QEL-XP99-NL LENGTH AS REQ	626	VON
1	EA	RIM CYLINDER	12E SERIES AS REQ X CONSTR CORE	626	BES
1	EA	SFIC PERMANENT CORE	TYPE AS REQ	626	BES
1	EA	SURFACE CLOSER	4040XP SCUSH X MTG BRKT, SPCR & PLATE AS REQ	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	RAIN DRIP	142A DW + 4"	AA	ZER
1	EA	GASKETING	188SBK PSA H & J	BK	ZER
1	EA	DOOR SWEEP	39A LENGTH AS REQ	A	ZER
1	EA	THRESHOLD	65A LENGTH AS REQ	A	ZER
1	EA	CARD READER	BY SECURITY PROVIDER		
1	EA	DOOR CONTACT	BY SECURITY PROVIDER		
1	EA	POWER SUPPLY	BY SECURITY PROVIDER		

-VERIFY TDI WINDSTORM "CERTIFICATION" OF SPECIFIED HARDWARE W/DOOR SYSTEM. HARDWARE BUILT AS BASIS-OF-DESIGN AROUND STEELCRAFT DOOR SYSTEM.

-INGRESS BY THE KEYPAD READER OR KEY OVERRIDE. FREE EGRESS BY PUSHPAD.

Hardware Group No. W205

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1HW 4.5 X 4.5 NRP	630	IVE
1	EA	STOREROOM LOCK	ND80HD SPA	626	SCH
1	EA	SFIC PERMANENT CORE	TYPE AS REQ	626	BES
1	EA	SURFACE CLOSER	4040XP SCUSH X MTG BRKT, SPCR & PLATE AS REQ	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	RAIN DRIP	142A DW + 4"	AA	ZER
1	EA	GASKETING	188SBK PSA H & J	BK	ZER
1	EA	DOOR SWEEP	39A LENGTH AS REQ	A	ZER
1	EA	THRESHOLD	65A LENGTH AS REQ	A	ZER

-VERIFY TDI WINDSTORM "CERTIFICATION" OF SPECIFIED HARDWARE W/DOOR SYSTEM. HARDWARE BUILT AS BASIS-OF-DESIGN AROUND STEELCRAFT DOOR SYSTEM.

Hardware Group No. W205WQ

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1HW 5 X 4.5 NRP	630	IVE
1	EA	STOREROOM LOCK	ND80HD SPA	626	SCH
1	EA	SFIC PERMANENT CORE	TYPE AS REQ	626	BES
1	EA	LOCK GUARD	LG1	630	IVE
1	EA	SURFACE CLOSER	4040XP SCUSH X MTG BRKT, SPCR & PLATE AS REQ	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	RAIN DRIP	142A DW + 4"	AA	ZER
1	EA	GASKETING	188SBK PSA H & J	BK	ZER
1	EA	DOOR SWEEP	39A LENGTH AS REQ	A	ZER
1	EA	THRESHOLD	65A LENGTH AS REQ	A	ZER

-VERIFY TDI WINDSTORM "CERTIFICATION" OF SPECIFIED HARDWARE W/DOOR SYSTEM. HARDWARE BUILT AS BASIS-OF-DESIGN AROUND STEELCRAFT DOOR SYSTEM.

Hardware Group No. W214

Provide each PR door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
6	EA	HINGE	5BB1HW 4.5 X 4.5 NRP	630	IVE
1	SET	CONST LATCHING BOLT	FB51P	630	IVE
1	EA	DUST PROOF STRIKE	DP2	626	IVE
1	EA	STOREROOM LOCK	ND80HD SPA	626	SCH
1	EA	SFIC PERMANENT CORE	TYPE AS REQ	626	BES
1	EA	SURFACE CLOSER	4040XP SCUSH X MTG BRKT, SPCR & PLATE AS REQ	689	LCN
2	EA	KICK PLATE	8400 10" X 1" LDW B-CS	630	IVE
1	EA	RAIN DRIP	142A DW + 4"	AA	ZER
1	EA	GASKETING	188SBK PSA H & J	BK	ZER
2	EA	DOOR SWEEP	39A LENGTH AS REQ	A	ZER
1	EA	THRESHOLD	65A LENGTH AS REQ	A	ZER

-VERIFY TDI WINDSTORM "CERTIFICATION" OF SPECIFIED HARDWARE W/DOOR SYSTEM. HARDWARE BUILT AS BASIS-OF-DESIGN AROUND STEELCRAFT DOOR SYSTEM.

Hardware Group No. W715

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1HW 4.5 X 4.5 NRP	630	IVE
1	EA	PANIC HARDWARE	99-NL LENGTH AS REQ	626	VON
1	EA	RIM CYLINDER	12E SERIES AS REQ X CONSTR CORE	626	BES
1	EA	SFIC PERMANENT CORE	TYPE AS REQ	626	BES
1	EA	SURFACE CLOSER	4040XP SCUSH X MTG BRKT, SPCR & PLATE AS REQ	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	RAIN DRIP	142A DW + 4"	AA	ZER
1	EA	GASKETING	188SBK PSA H & J	BK	ZER
1	EA	DOOR SWEEP	39A LENGTH AS REQ	A	ZER
1	EA	THRESHOLD	65A LENGTH AS REQ	A	ZER

-VERIFY TDI WINDSTORM "CERTIFICATION" OF SPECIFIED HARDWARE W/DOOR SYSTEM. HARDWARE BUILT AS BASIS-OF-DESIGN AROUND STEELCRAFT DOOR SYSTEM.

END OF SECTION.

SECTION 088000 - GLAZING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:

1. Glazing for the following products and applications, including those specified in other Sections where glazing requirements are specified by reference to this Section:
   a. Doors.
   b. Glazed curtain walls.
   c. Interior borrowed lites.

1.2 DEFINITIONS

A. Glass Manufacturers: Firms that produce primary glass, fabricated glass, or both, as defined in referenced glazing publications.

B. Glass Thicknesses: Indicated by thickness designations in millimeters according to ASTM C 1036.

C. Interspace: Space between lites of an insulating-glass unit.

1.3 PERFORMANCE REQUIREMENTS

A. General: Installed glazing systems shall withstand normal thermal movement and wind and impact loads (where applicable) without failure, including loss or glass breakage attributable to the following: defective manufacture, fabrication, or installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction.

B. Delegated Design: Design glass, including comprehensive engineering analysis according to ICC's 2006 International Building Code by a qualified professional engineer, using the following design criteria:

1. Design Wind Pressures: As indicated on Drawings.
2. Vertical Glazing: For glass surfaces sloped 15 degrees or less from vertical, design glass to resist design wind pressure based on glass type factors for short-duration load.
3. Maximum Lateral Deflection: For glass supported on all four edges, limit center-of-glass deflection at design wind pressure to not more than 1/50 times the short-side length or 1 inch, whichever is less.

C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on glass framing members and glazing components.

1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.
2. corrective measures including the use of specially formulated primers.

D. Windborne-Debris Impact Resistance: Pass missile-impact and cyclic-pressure tests when tested according to ASTM E 1886 and testing information in ASTM E 1996 for Wind Zone 2.

1. Large-Missile Test: For glazed openings located within 30 feet of grade.
2. Small-Missile Test: For glazed openings located more than 30 feet above grade.

1.4 ACTION SUBMITTALS

A. Product Data: For each glass product and glazing material indicated.

B. Glass Samples: For each type of glass except clear glass; 12 inches square.

C. Glazing Accessory Samples: For gaskets, sealants, and colored spacers, in 12-inch lengths. Install sealant Samples between two strips of material representative in color of the adjoining framing system.

D. Glazing Schedule: List glass types and thicknesses for each size opening and location. Use same designations indicated on Drawings.

E. Delegated-Design Submittal: For glass indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.5 INFORMATIONAL SUBMITTALS

A. Product Certificates: For glass and glazing products, from manufacturer.

B. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for insulating glass.

C. Warranties: Sample of special warranties.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications for Insulating-Glass Units with Sputter-Coated, Low-E Coatings: A qualified insulating-glass manufacturer who is approved and certified by coated-glass manufacturer.

B. Installer Qualifications: A qualified installer who employs glass installers for this Project who are certified under the National Glass Association's Certified Glass Installer Program.

C. Source Limitations for Glass: Obtain insulating glass from single source from single manufacturer for each glass type.

D. Source Limitations for Glazing Accessories: Obtain from single source from single manufacturer for each product and installation method.

E. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below, unless more stringent requirements are indicated. Refer to these publications for glazing terms not otherwise defined in this Section or in referenced standards.

1. IGMA Publication for Insulating Glass: SIGMA TM-3000, "North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial and Residential Use."

F. Safety Glazing Labeling: Where safety glazing labeling is indicated, permanently mark glazing with certification label of the SGCC or another certification agency acceptable to authorities having jurisdiction. Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.

G. Insulating-Glass Certification Program: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of IGCC.

H. Preinstallation Conference: Conduct conference at Project site.

1. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
2. Review temporary protection requirements for glazing during and after installation.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Protect glazing materials according to manufacturer's written instructions. Prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.

B. Comply with insulating-glass manufacturer's written recommendations for venting and sealing units to avoid hermetic seal ruptures due to altitude change.

1.8 PROJECT CONDITIONS

A. Environmental Limitations: Do not proceed with glazing when ambient and substrate temperature conditions are outside limits permitted by glazing material manufacturers and when glazing channel substrates are wet from rain, frost, condensation, or other causes.

1. Do not install glazing sealants when ambient and substrate temperature conditions are outside limits permitted by sealant manufacturer or below 40 deg F.

1.9 WARRANTY

A. Manufacturer's Special Warranty for Coated-Glass Products: Manufacturer's standard form in which coated-glass manufacturer agrees to replace coated-glass units that deteriorate within specified warranty period. Deterioration of coated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning coated glass contrary to manufacturer's written instructions. Defects include peeling, cracking, and other indications of deterioration in coating.

1. Warranty Period: 10 years from date of Substantial Completion.

B. Manufacturer's Special Warranty on Insulating Glass: Manufacturer's standard form in which insulating-glass manufacturer agrees to replace insulating-glass units that deteriorate within specified warranty period. Deterioration of insulating glass is defined as failure of hermetic seal under normal use that is not attributed to glass breakage or to maintaining and cleaning insulating glass contrary to manufacturer's written instructions. Evidence of failure is the obstruction of vision by dust, moisture, or film on interior surfaces of glass.

1. Warranty Period: 10 years from date of Substantial Completion.

C. Manufacturer's Special Warranty on Laminated Glass: Manufacturer's standard form in which laminated glass manufacturer agrees to replace laminated glass units that deteriorate within specified warranty period. Deterioration of laminated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning laminated glass contrary to manufacturer's written instructions.

1. Warranty Period: 5 years from date of Substantial Completion.

D. Manufacturer's Special Warranty on Tempered Glass: Manufacturer's standard form in which tempered glass manufacturer agrees to replace tempered glass units that deteriorate within specified warranty period. Deterioration of tempered glass is defined as units that break spontaneously as a result of Nickel Sulfide (NiS) inclusions at a rate exceeding 0.8 percent (8/1000).

1. Warranty Period: 5 years from date of Substantial Completion

PART 2 - PRODUCTS

2.1 GLASS PRODUCTS, GENERAL

A. Thickness: Where glass thickness is indicated, it is a minimum. Provide glass lites in thicknesses as needed to comply with requirements indicated.

1. Minimum Glass Thickness for Exterior Lites: Not less than 6.0 mm.

B. Strength: Where float glass is indicated, provide Kind HS heat-treated float glass. Where fully tempered glass is indicated, provide Kind FT heat-treated float glass.

C. Thermal and Optical Performance Properties: Provide glass with performance properties specified, as indicated in manufacturer's published test data, based on procedures indicated below:

1. For monolithic-glass lites, properties are based on units with lites 6.0 mm thick.
2. For insulating-glass units, properties are based on units of thickness indicated for overall unit and for each lite.
3. U-Factors: Center-of-glazing values, according to NFRC 100 and based on LBL's WINDOW 7.6 computer program, expressed as Btu/sq. ft. x h x deg F.
4. Solar Heat-Gain Coefficient and Visible Transmittance: Center-of-glazing values, according to NFRC 200 and based on LBL's WINDOW 7.6 computer program.
5. Visible Reflectance: Center-of-glazing values, according to NFRC 300.

2.2 GLASS PRODUCTS

A. Float Glass Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. AGC Flat Glass North America, Inc: www.na.agc-flatglass.com.
2. Cristacurva Company: www.cristacurva.com.
3. Guardian Glass; www.guardianglass.com.
4. Oldcastle Glass: www.oldcastle.com.
5. Pilkington North America Inc: www.pilkington.com/na.
6. Technoglass; www.technoglass.com.
7. Viracon, Inc.; www.viracon.com.
8. Vitro Architectural Glass: www.vitroglazings.com.

B. Clear Annealed Float Glass: ASTM C 1036, Type I, Class 1 (clear), Quality-Q3.

C. Heat-Treated Float Glass: ASTM C 1048; Type I; Kind HS (heat-strengthened) and FT (fully tempered) as indicated, using clear glass.

1. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed unless otherwise indicated.
2. For uncoated glass, comply with requirements for Condition A.
3. For coated vision glass, comply with requirements for Condition C (other coated glass).
4. Provide Kind HS (heat-strengthened) float glass typical, unless otherwise noted.
5. Provide Kind FT (fully-tempered) float glass only in those areas where safety glass is required to comply with performance requirements, and where indicated.

2.3 LAMINATED GLASS

A. Laminated Glass: ASTM C 1172. Use materials that have a proven record of no tendency to bubble, discolor, or lose physical and mechanical properties after fabrication and installation.

1. Construction: Laminate glass with polyvinyl butyral interlayer to comply with interlayer manufacturer's written instructions.
2. Interlayer Thickness: Provide thickness and number of layers as needed to comply with requirements.
3. Interlayer Color: Translucent gray.

2.4 INSULATING GLASS

A. Insulating-Glass Units: Factory-assembled units consisting of sealed lites of glass separated by a dehydrated interspace, qualified according to ASTM E 2190, and complying with other requirements specified.

1. Sealing System: Dual seal, with manufacturer's standard primary and secondary.
2. Spacer: Thermally broken aluminum, black color.

B. Glass: Comply with applicable requirements in "Glass Products" Article as indicated by designations in "Insulating-Glass Types" Article.

2.5 GLAZING GASKETS

A. Dense Compression Gaskets: Molded or extruded gaskets of profile and hardness required to maintain watertight seal, made from one of the following:

1. Silicone complying with ASTM C 1115.

B. Soft Compression Gaskets: Extruded or molded, closed-cell, integral-skinned EPDM, silicone or thermoplastic polyolefin rubber gaskets complying with ASTM C 509, Type II, black; of profile and hardness required to maintain watertight seal.

1. Application: Use where soft compression gaskets will be compressed by inserting dense compression gaskets on opposite side of glazing or pressure applied by means of pressure-glazing stops on opposite side of glazing.

2.6 GLAZING SEALANTS

A. General:

1. Compatibility: Provide glazing sealants that are compatible with one another and with other materials they will contact, including glass products, seals of insulating-glass units, and glazing channel substrates, under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.

2. Suitability: Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated and for conditions existing at time of installation.
3. Colors of Exposed Glazing Sealants: As selected by Architect from manufacturer's full range.

B. Glazing Sealant: Neutral-curing silicone glazing sealant complying with ASTM C 920, Type S, Grade NS, Class 100/50, Use NT.

1. Products: Subject to compliance with requirements, provide one of the following:
   a. Dow Corning Corporation; Dowsil 795.
   b. GE Advanced Materials - Silicones; SilPruf SCS2000.
   c. Tremco Incorporated; Spectrem 2.

C. Glazing Sealants for Fire-Rated Glazing Products: Products that are approved by testing agencies that listed and labeled fire-resistant glazing products with which they are used for applications and fire-protection ratings indicated.

2.7 GLAZING TAPES

A. Back-Bedding Mastic Glazing Tapes: Preformed, butyl-based, 100 percent solids elastomeric tape; nonstaining and nonmigrating in contact with nonporous surfaces; with or without spacer rod as recommended in writing by tape and glass manufacturers for application indicated; and complying with ASTM C 1281 and AAMA 800 for products indicated below:

1. AAMA 804.3 tape, where indicated.
2. AAMA 806.3 tape, for glazing applications in which tape is subject to continuous pressure.
3. AAMA 807.3 tape, for glazing applications in which tape is not subject to continuous pressure.

B. Expanded Cellular Glazing Tapes: Closed-cell, PVC foam tapes; factory coated with adhesive on both surfaces; and complying with AAMA 800 for the following types:

1. AAMA 810.1, Type 1, for glazing applications in which tape acts as the primary sealant.
2. AAMA 810.1, Type 2, for glazing applications in which tape is used in combination with a full bead of liquid sealant.

2.8 MISCELLANEOUS GLAZING MATERIALS

A. General: Provide products of material, size, and shape complying with referenced glazing standard, requirements of manufacturers of glass and other glazing materials for application indicated, and with a proven record of compatibility with surfaces contacted in installation.

B. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.

C. Setting Blocks: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.

D. Spacers: Elastomeric blocks or continuous extrusions of hardness required by glass manufacturer to maintain glass lites in place for installation indicated.

E. Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement (side walking).

2.9 FABRICATION OF GLAZING UNITS

A. Fabricate glazing units in sizes required to fit openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with written instructions of product manufacturer and referenced glazing publications, to comply with system performance requirements.

B. Clean-cut or flat-grind vertical edges of butt-glazed monolithic lites to produce square edges with slight chamfers at junctions of edges and faces.

C. Grind smooth and polish exposed glass edges and corners.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine framing, glazing channels, and stops, with Installer present, for compliance with the following:

1. Manufacturing and installation tolerances, including those for size, squareness, and offsets at corners.
2. Presence and functioning of weep systems.
3. Minimum required face and edge clearances.
4. Effective sealing between joints of glass-framing members.

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

3.2 PREPARATION

A. Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings not firmly bonded to substrates.

B. Examine glazing units to locate exterior and interior surfaces. Label or mark units as needed so that exterior and interior surfaces are readily identifiable. Do not use materials that will leave visible marks in the completed work.

3.3 GLAZING, GENERAL

A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.

B. Adjust glazing channel dimensions as required by Project conditions during installation to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances.

C. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass is glass with edge damage or other imperfections that, when installed, could weaken glass and impair performance and appearance.

D. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.

E. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.

F. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.

G. Provide spacers for glass lites where length plus width is larger than 50 inches.

1. Locate spacers directly opposite each other on both inside and outside faces of glass. Install correct size and spacing to preserve required face clearances, unless gaskets and glazing tapes are used that have demonstrated ability to maintain required face clearances and to comply with system performance requirements.
2. Provide 1/8-inchminimum bite of spacers on glass and use thickness equal to sealant width. With glazing tape, use thickness slightly less than final compressed thickness of tape.

H. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and according to requirements in referenced glazing publications.

I. Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.

J. Set glass lites with proper orientation so that coatings face exterior or interior as specified.

K. Square cut wedge-shaped gaskets at corners and install gaskets in a manner recommended by gasket manufacturer to prevent corners from pulling away; seal corner joints and butt joints with sealant recommended by gasket manufacturer.

3.4 TAPE GLAZING

A. Position tapes on fixed stops so that, when compressed by glass, their exposed edges are flush with or protrude slightly above sightline of stops.

B. Install tapes continuously, but not necessarily in one continuous length. Do not stretch tapes to make them fit opening.

C. Cover vertical framing joints by applying tapes to heads and sills first and then to jambs. Cover horizontal framing joints by applying tapes to jambs and then to heads and sills.

D. Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant approved by tape manufacturer.

E. Do not remove release paper from tape until right before each glazing unit is installed.

F. Apply heel bead of elastomeric sealant.

G. Center glass lites in openings on setting blocks and press firmly against tape by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings.

H. Apply cap bead of elastomeric sealant over exposed edge of tape.

3.5 GASKET GLAZING (DRY)

A. Cut compression gaskets to lengths recommended by gasket manufacturer to fit openings exactly, with allowance for stretch during installation.

B. Insert soft compression gasket between glass and frame or fixed stop so it is securely in place with joints miter cut and bonded together at corners.

C. Installation with Drive-in Wedge Gaskets: Center glass lites in openings on setting blocks and press firmly against soft compression gasket by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.

D. Installation with Pressure-Glazing Stops: Center glass lites in openings on setting blocks and press firmly against soft compression gasket. Install dense compression gaskets and pressure-glazing stops, applying pressure uniformly to compression gaskets. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.

E. Install gaskets so they protrude past face of glazing stops.

3.6 SEALANT GLAZING (WET)

A. Install continuous spacers, or spacers combined with cylindrical sealant backing, between glass lites and glazing stops to maintain glass face clearances and to prevent sealant from extruding into glass channel and blocking weep systems until sealants cure. Secure spacers or spacers and backings in place and in position to control depth of installed sealant relative to edge clearance for optimum sealant performance.

B. Force sealants into glazing channels to eliminate voids and to ensure complete wetting or bond of sealant to glass and channel surfaces.

C. Tool exposed surfaces of sealants to provide a substantial wash away from glass.

3.7 CLEANING AND PROTECTION

A. Protect exterior glass from damage immediately after installation by attaching crossed streamers to framing held away from glass. Do not apply markers to glass surface. Remove nonpermanent labels and clean surfaces.

B. Protect glass from contact with contaminating substances resulting from construction operations. If, despite such protection, contaminating substances do come into contact with glass, remove substances immediately as recommended in writing by glass manufacturer.

C. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for buildup of dirt, scum, alkaline deposits, or stains; remove as recommended in writing by glass manufacturer.

D. Remove and replace glass that is broken, chipped, cracked, or abraded or that is damaged from natural causes, accidents, and vandalism, during construction period.

E. Wash glass on both exposed surfaces in each area of Project not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash glass as recommended in writing by glass manufacturer.

3.8 MONOLITHIC GLASS SCHEDULE

A. Clear annealed float glass.

1. Minimum Thickness: 6 mm.
2. Application: Non-safety interior glazing.

B. Clear fully tempered float glass.

1. Thickness: 6 mm.
2. Application: Provide in the following locations:
   a. Glazed lites in interior doors, except fire-rated doors.
   b. Glazed sidelights to doors, except in fire-rated walls and partitions.
   c. Other locations indicated on drawings or required by applicable codes and regulations.

3.9 INSULATING-GLASS SCHEDULE

A. Clear, Low-E-Coated, Insulating Laminated Glass (Impact-Resistant):

1. Overall Unit Thickness: 1-5/16 inch (1 inch for entrance doors).
2. Minimum Thickness of Each Glass Lite: 6 mm.
3. Outdoor Lite: Clear float glass w/ low-E coating on #2 surface, heat strengthened.
4. Low-E Coating: Vitro Solarban 90.
5. Interspace Content: Air.
6. Indoor Lite: Laminated glass consisting of 2 lites of 6mm clear heat-strengthened float glass with 0.060 inch PVB interlayer.
7. Solar Heat Gain Coefficient: 0.23.
8. U-value (Winter/Summer): 0.29/0.27
9. Visible Light Transmission Factor: 51
10. Use: Exterior storefront and entrance door glazing.

END OF SECTION

SECTION 088863 - INTEGRATED GLASS AND BLIND ASSEMBLIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:

1. Insulating glass assemblies with integral horizontal louver blinds.

B. Related Requirements:

1. Section 081113 – Hollow Metal Doors and Frames: Hollow metal frames to receive integrated glass and blind assemblies.
2. Section 081416 - Flush Wood Doors: Wood doors to receive integrated glass and blind assemblies.
3. Section 088000 - Glazing: Glazing and accessories.

1.2 SUBMITTALS

A. Submittals for Review:

1. Shop Drawings: Include elevations and details showing joint locations, transitions, and terminations, and anchoring details.
2. Product Data: Include preparation instructions and recommendations, Storage and handling requirements, and installation methods.
3. Samples: Manufacturer's sample box showing available colors.

1.3 QUALITY ASSURANCE

A. Obtain each type of integrated glass and blind assembly from single manufacturer.

B. Insulating Glass Manufacturer Qualifications: Qualified insulating glass manufacturer, approved and certified by integrated glass and blind assembly manufacturer.

C. Installer Qualifications:

1. Minimum 3 years experience in work of this Section.
2. Certified under AGA Certified Installer Program.

D. Integrated Glass and Blind Assemblies: Tested and labeled to CPSC 16 CFR 1201.

E. Mockup:

1. Size: Minimum 2 x 2 feet.
2. Show integrated glass and blind assembly and glazing accessories.
3. Locate where directed.
4. Approved mockup may not remain as part of the Work.

1.4 DELIVERY, STORAGE AND HANDLING

A. Delivery glass with temporary label on each light identifying manufacturer, glass type, quality, and nominal thickness.

B. Store glass in areas least subject to traffic and falling objects. Keep storage area dry.

C. Stack individual panels on edge leaned slightly against upright supports with separators between panels.

1.5 PROJECT CONDITIONS

A. Maintain temperature, humidity, and ventilation within limits recommended by glass manufacturer.

B. Do not install products under environmental conditions outside manufacturer's limits.

1.6 WARRANTIES

A. Furnish manufacturer's 20 year warranty providing for replacement of defective integrated glass and blind assemblies due to improper workmanship and materials, under normal installation, use, service and maintenance

PART 2 - PRODUCTS

2.1 INTERIOR WINDOW UNITS

A. Basis-of-Design: Subject to compliance with requirements, provide Vision Control with Thumbwheel as manufactured by Unicel Architectural; www.unicelarchitectural.com.

1. Substitutions: Not permitted.

B. Insulating Glazing Unit:

1. Clear Insulating Glass Units: Factory assembled, consisting of sealed glass panes separated by dehydrated interspaces.
2. Overall Unit Thickness: 2-1/2 inch.
3. Minimum Thickness of Each Glass Lite: 6 mm.
4. Outdoor Lite: Clear tempered glass.
5. Interspace: 2 inches, filled with air.
6. Indoor Lite: Clear tempered glass.

C. Horizontal louver blinds:

1. Blades: 6010-T8 aluminum alloy, 3/8 inch thick, interlocking when closed.
2. Color: To be selected by Architect from manufacturer's full color range.

D. Thumbwheel Operator:

1. Designed to tilt blinds.
2. Thumbwheel accessible [on both sides][from room side][from corridor side] of unit.

2.2 ACCESSORIES

A. Glazing Stops: Extruded aluminum stops, 3/4 inches wide, painted to match louver blades.

B. Glazing Accessories as specified in Section 088000 "Glazing."

2.3 FABRICATION

A. Fabricate glazing units in required sizes with edge and face clearances, edge and surface conditions, and bite in accordance with manufacturer requirements and reference standards, to comply with system performance requirements.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that openings conform to details; dimensions, and tolerances indicated on approved Shop Drawings.

3.2 PREPARATION

A. Clean surfaces to receive glass units prior to installation.

B. Prepare surfaces using methods recommended by manufacturer.

3.3 INSTALLATION

A. Install in accordance with manufacturer's instructions and approved Shop Drawings.

B. Set glazing without bending, twisting, or forcing of units.

C. Do not allow glass to rest on or contact framing members.

3.4 CLEANING

A. Clean glass surfaces; remove temporary labels and foreign matter.

3.5 ADJUSTING

A. Replace cracked, broken, and imperfect glass, and glass that has been improperly installed.

3.6 PROTECTION

A. Protect installed products until completion of project.

END OF SECTION

SECTION 089000 - LOUVERS AND VENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Fixed, extruded-aluminum louvers.

1.2 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design louvers, including comprehensive engineering analysis by a qualified professional engineer, using structural performance requirements and design criteria indicated.

B. Structural Performance: Louvers shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated without permanent deformation of louver components, noise or metal fatigue caused by louver blade rattle or flutter, or permanent damage to fasteners and anchors. Wind pressures shall be considered to act normal to the face of the building.

1. Wind Loads: Determine loads based on pressures as indicated on Drawings.

C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes, without buckling, opening of joints, overstressing of components, failure of connections, or other detrimental effects.

1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

D. Louver Performance Ratings: Provide louvers complying with requirements specified, as demonstrated by testing manufacturer's stock units identical to those provided, except for length and width according to AMCA 500-L.

E. Windborne-Debris Impact Resistance: Pass missile-impact and cyclic-pressure tests when tested according to ASTM E 1886 and testing information in ASTM E 1996 for Wind Zone indicated.

1. Large-Missile Test: For openings located within 30 feet of grade.
2. Small-Missile Test: For openings located more than 30 feet above grade.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

1. For louvers specified to bear AMCA seal, include printed catalog pages showing specified models with appropriate AMCA Certified Ratings Seals.

B. Shop Drawings: For louvers and accessories. Include plans, elevations, sections, details, and attachments to other work. Show frame profiles and blade profiles, angles, and spacing.

1. Show weep paths, gaskets, flashing, sealant, and other means of preventing water intrusion.
2. Show mullion profiles and locations.

3. Wiring Diagrams: For power, signal, and control wiring for motorized adjustable louvers.

C. Samples for Verification: For each type of metal finish required.

D. Delegated-Design Submittal: For louvers indicated to comply with structural performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

E. Product Test Reports: Based on evaluation of comprehensive tests performed according to AMCA 500-L by a qualified testing agency or by manufacturer and witnessed by a qualified testing agency, for each type of louver and showing compliance with performance requirements specified. Reference standard ANSI/ACMA Standard 550-09.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain louvers and vents from single source from a single manufacturer where indicated to be of same type, design, or factory-applied color finish.

B. Welding: Qualify procedures and personnel according to the following:

1. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."
2. AWS D1.3, "Structural Welding Code - Sheet Steel."
3. AWS D1.6, "Structural Welding Code - Stainless Steel."

C. SMACNA Standard: Comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" for fabrication, construction details, and installation procedures.

D. UL and NEMA Compliance: Provide motors and related components for motor-operated louvers that are listed and labeled by UL and comply with applicable NEMA standards.

1.5 PROJECT CONDITIONS

A. Field Measurements: Verify actual dimensions of openings by field measurements before fabrication.

1.6 WARRANTY

A. Special Finish Warranty: Standard form in which manufacturer agrees to repair finishes or replace aluminum that shows evidence of deterioration of factory-applied finishes within specified warranty period.

1. Deterioration includes, but is not limited to, the following:
   a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
   b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
   c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

2. Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Aluminum Extrusions: ASTM B 221, Alloy 6063-T5, T-52, or T6.

B. Aluminum Sheet: ASTM B 209, Alloy 3003 or 5005 with temper as required for forming, or as otherwise recommended by metal producer for required finish.

C. Aluminum Castings: ASTM B 26/B 26M, Alloy 319.

D. Fasteners: Use types and sizes to suit unit installation conditions.

1. Use tamper-resistant screws for exposed fasteners unless otherwise indicated.
2. For fastening aluminum, use aluminum or 300 series stainless-steel fasteners.
3. For fastening galvanized steel, use hot-dip-galvanized steel or 300 series stainless-steel fasteners.
4. For fastening stainless steel, use 300 series stainless-steel fasteners.
5. For color-finished louvers, use fasteners with heads that match color of louvers.

E. Postinstalled Fasteners for Concrete and Masonry: Torque-controlled expansion anchors, made from stainless-steel components, with capability to sustain, without failure, a load equal to 4 times the loads imposed, for concrete, or 6 times the load imposed, for masonry, as determined by testing per ASTM E 488, conducted by a qualified independent testing agency.

F. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

2.2 FABRICATION, GENERAL

A. Assemble louvers in factory to minimize field splicing and assembly. Disassemble units as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.

B. Maintain equal louver blade spacing, including separation between blades and frames at head and sill, to produce uniform appearance.

C. Fabricate frames, including integral sills, to fit in openings of sizes indicated, with allowances made for fabrication and installation tolerances, adjoining material tolerances, and perimeter sealant joints.

D. Include supports, anchorages, and accessories required for complete assembly.

E. Provide vertical mullions of type and at spacings indicated, but not more than recommended by manufacturer, or 72 inches o.c., whichever is less.

1. Fully Recessed Mullions: Where indicated, provide mullions fully recessed behind louver blades. Where length of louver exceeds fabrication and handling limitations, fabricate with close-fitting blade splices designed to permit expansion and contraction.
2. Semirecessed Mullions: Where indicated, provide mullions partly recessed behind louver blades so louver blades appear continuous. Where length of louver exceeds fabrication and handling limitations, fabricate with interlocking split mullions and close-fitting blade splices designed to permit expansion and contraction.
3. Exposed Mullions: Where indicated, provide units with exposed mullions of same width and depth as louver frame. Where length of louver exceeds fabrication and handling limitations, provide interlocking split mullions designed to permit expansion and contraction.
4. Exterior Corners: Prefabricated corner units with mitered and welded blades and with fully recessed mullions at corners.

F. Provide subsills made of same material as louvers for recessed louvers.

G. Join frame members to each other and to fixed louver blades with fillet welds concealed from view unless otherwise indicated or size of louver assembly makes bolted connections between frame members necessary.

2.3 FIXED, EXTRUDED-ALUMINUM LOUVERS

A. Horizontal Impact- and Storm-Resistant Louver, Drainable:

1. Basis-of-Design: Subject to compliance with requirements, provide ELF6375DXD Drainable Stationary Louver as manufactured by Ruskin Company, or comparable products by one of the following:
   a. Airolite Company, LLC.
   b. Construction Specialties, Inc.
   c. Greenheck Fan Corporation.
   d. Nystrom Building Products.
   e. Reliable Products, Inc.
2. Louver Depth: 6 inches or as indicated on drawings.
3. Frame and Blade Nominal Thickness: Not less than 0.080 inch.
4. Louver Performance Ratings:
   a. Free Area: Not less than as required by mechanical equipment as indicated on drawings.
   b. Wind-Driven Rain Performance: Not less than 95 percent effectiveness when subjected to a rainfall rate of 8 inches per hour and a wind speed of 50 mph.
5. AMCA Seal: Mark units with AMCA Certified Ratings Seal.

2.4 LOUVER SCREENS

A. General: Provide screen at each exterior louver.

1. Screen Location for Fixed Louvers: Interior face.
2. Screening Type: Bird screening except where insect screening is indicated.

B. Secure screen frames to louver frames with stainless-steel machine screws, spaced a maximum of 6 inches from each corner and at 12 inches o.c.

C. Louver Screen Frames: Fabricate with mitered corners to louver sizes indicated.

1. Metal: Same kind and form of metal as indicated for louver to which screens are attached. Reinforce extruded-aluminum screen frames at corners with clips.
2. Finish: Same finish as louver frames to which louver screens are attached.
3. Type: Rewirable frames with a driven spline or insert.

D. Louver Screening for Aluminum Louvers:

1. Bird Screening: Aluminum, 1/2-inch- square mesh, 0.063-inch wire.
2. Insect Screening: Aluminum, 18-by-16 mesh, 0.012-inch wire.

2.5 FINISHES

A. General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Finish louvers after assembly.

C. High-Performance Organic Finish, Mica Fluoropolymer: Two-coat fluoropolymer finish complying with AAMA 2605, with suspended mica flakes containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

1. Color: As indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and openings, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance.

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

3.2 PREPARATION

A. Coordinate setting drawings, diagrams, templates, instructions, and directions for installation of anchorages that are to be embedded in concrete or masonry construction. Coordinate delivery of such items to Project site.

3.3 INSTALLATION

A. Locate and place louvers and vents level, plumb, and at indicated alignment with adjacent work.

B. Use concealed anchorages where possible. Provide brass or lead washers fitted to screws where required to protect metal surfaces and to make a weathertight connection.

C. Form closely fitted joints with exposed connections accurately located and secured.

D. Provide perimeter reveals and openings of uniform width for sealants and joint fillers, as indicated.

E. Repair finishes damaged by cutting, welding, soldering, and grinding. Restore finishes so no evidence remains of corrective work. Return items that cannot be refinished in the field to the factory, make required alterations, and refinish entire unit or provide new units.

F. Protect unpainted galvanized and nonferrous-metal surfaces that will be in contact with concrete, masonry, or dissimilar metals from corrosion and galvanic action by applying a heavy coating of bituminous paint or by separating surfaces with waterproof gaskets or nonmetallic flashing.

G. Install concealed gaskets, flashings, joint fillers, and insulation as louver installation progresses, where weathertight louver joints are required. Comply with Division 07 Section "Joint Sealants" for sealants applied during louver installation.

3.4 ADJUSTING AND CLEANING

A. Test operation of adjustable louvers and adjust as needed to produce fully functioning units that comply with requirements.

B. Clean exposed surfaces of louvers and vents that are not protected by temporary covering, to remove fingerprints and soil during construction period. Do not let soil accumulate during construction period.

C. Before final inspection, clean exposed surfaces with water and a mild soap or detergent not harmful to finishes. Thoroughly rinse surfaces and dry.

D. Restore louvers and vents damaged during installation and construction so no evidence remains of corrective work. If results of restoration are unsuccessful, as determined by Architect, remove damaged units and replace with new units.

1. Touch up minor abrasions in finishes with air-dried coating that matches color and gloss of, and is compatible with, factory-applied finish coating.

END OF SECTION 089000

SECTION 090561 - COMMON WORK RESULTS FOR FLOORING PREPARATION

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. This section applies to floors within Project scope identified in the Contract Documents as to receive the following types of floor coverings:

1. Resilient flooring.
2. Carpeting.
3. Thin-set ceramic tile.
4. Fluid applied resinous flooring.

B. Preparation of existing concrete floor slabs for installation of floor coverings.

C. Testing of concrete floor slabs for moisture and pH by flooring contractor.

D. Remediation of concrete floor slabs due to unsatisfactory moisture or pH conditions.

1. Contractor shall perform all specified remediation of concrete floor slabs. If such remediation is indicated by testing agency's report and is due to a condition not under Contractor's control or could not have been predicted by examination prior to entering into the contract, a contract modification will be issued.

1.2 REFERENCES

A. ASTM C472 - Standard Test Methods for Physical Testing of Gypsum, Gypsum Plasters and Gypsum Concrete; 1999 (Reapproved 2009).

B. ASTM F710 - Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring; 2011.

C. ASTM F1869 - Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride; 2011.

D. ASTM F2170 - Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes; 2011.

E. RFCI (RWP) - Recommended Work Practices for Removal of Resilient Floor Coverings; Resilient Floor Covering Institute; October 2011.

1.3 SUBMITTALS

A. Visual Observation Report: For existing floor coverings to be removed.

B. Floor Covering and Adhesive Manufacturers' Product Literature: For each specific combination of substrate, floor covering, and adhesive to be used; showing:

1. Moisture and pH limits and test methods.
2. Manufacturer's required bond/compatibility test procedure.

C. Testing Agency's Report: Include:

1. Description of areas tested; include floor plans and photographs if helpful.
2. Summary of conditions encountered.
3. Moisture and pH test reports.
4. Copies of specified test methods.
5. Recommendations for remediation of unsatisfactory surfaces.
6. Submit report to Architect.
7. Submit report not more than two business days after conclusion of testing.

D. Adhesive Bond and Compatibility Test Report.

E. Copy of RFCI Recommended Work Practices for Removal of Resilient Floor Coverings.

F. Remedial Materials Product Data: Manufacturer's published data on each product to be used for remediation.

1. Manufacturer's qualification statement.
2. Test reports indicating compliance with specified performance requirements, performed by nationally recognized independent testing agency.
3. Manufacturer's installation instructions.
4. Specimen Warranty: Copy of warranty to be issued by coating manufacturer and certificate of underwriter's coverage of warranty.

1.4 QUALITY ASSURANCE

A. Moisture and pH testing shall be performed by an independent testing agency employed and paid by Contractor.

B. Contractor may perform adhesive and bond test with his own personnel or hire a testing agency.

C. Testing Agency Qualifications: Independent testing agency experienced in the types of testing specified.

1. Submit evidence of experience consisting of at least 3 test reports of the type required, with project Owner's project contact information.

D. Contractor's Responsibility Relating to Independent Agency Testing:

1. Provide access for and cooperate with testing agency.
2. Confirm date of start of testing at least 10 days prior to actual start.
3. Allow at least 4 business days on site for testing agency activities.
4. Achieve and maintain specified ambient conditions.
5. Notify Architect when specified ambient conditions have been achieved and when testing will start.

E. Remedial Coating Installer Qualifications: Company specializing in performing work of the type specified in this section, trained by or employed by coating manufacturer, and able to provide at least 3 project references showing at least 3 years' experience installing moisture emission coatings.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, handle, and protect products in accordance with manufacturer’s instructions and recommendations.

B. Deliver materials in manufacturer’s packaging; include installation instructions.

C. Keep materials from freezing.

1.6 FIELD CONDITIONS

A. Maintain ambient temperature in spaces where concrete testing is being performed, and for at least 48 hours prior to testing, at not less than 65 degrees F or more than 85 degrees F.

B. Maintain relative humidity in spaces where concrete testing is being performed, and for at least 48 hours prior to testing, at not less than 40 percent and not more than 60 percent.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Patching Compound: Floor covering manufacturer's recommended product, suitable for conditions, and compatible with adhesive and floor covering. In the absence of any recommendation from flooring manufacturer, provide a product with the following characteristics:

1. Cementitious moisture-, mildew-, and alkali-resistant compound, compatible with floor, floor covering, and floor covering adhesive, and capable of being feathered to nothing at edges.
2. Latex or polyvinyl acetate additions are permitted; gypsum content is prohibited.
3. Compressive Strength: 3000 psi, minimum, after 28 days, when tested in accordance with ASTM C109/C109M or ASTM C472, whichever is appropriate.

B. Alternate Flooring Adhesive: Floor covering manufacturer's recommended product, suitable for the moisture and pH conditions present; low-VOC. In the absence of any recommendation from flooring manufacturer, provide a product recommended by adhesive manufacturer as suitable for substrate and floor covering and for conditions present.

C. Remedial Floor Coating: Single- or multi-layer coating or coating/overlay combination intended by its manufacturer to resist water vapor transmission to degree sufficient to meet flooring manufacturer's emission limits, resistant to the level of pH found, and suitable for adhesion of flooring without further treatment.

1. Thickness: 1/8 inch, maximum.
2. If testing agency recommends any particular products, use recommended product. If no product is recommended, use one of the following:
   a. ARDEX Engineered Cements; ARDEX MC RAPID, with ARDEX FEATHERFINISH: www.ardexamericas.com.
   b. Koster American Corporation; Koster VAP I 2000, with Koster SL Premium overlay: www.kosterusa.com.

PART 3 - EXECUTION

3.1 CONCRETE SLAB PREPARATION

A. Perform following operations in the order indicated:

1. Existing concrete slabs (on-grade and elevated) with existing floor coverings:
   a. Visual observation of existing floor covering, for adhesion, water damage, alkaline deposits, and other defects.
   b. Removal of existing floor covering.

2. Existing concrete slabs with coatings or penetrating sealers/hardeners/dustproofers:
   a. Do not attempt to remove coating or penetrating material.
   b. Do not abrade surface.

3. Preliminary cleaning.
4. Moisture vapor emission tests; 3 tests in the first 1000 square feet and one test in each additional 1000 square feet, unless otherwise indicated or required by flooring manufacturer.
5. Internal relative humidity tests; in same locations as moisture vapor emission tests, unless otherwise indicated.
6. pH tests; in same locations as moisture vapor emission tests, unless otherwise indicated.
7. Specified remediation, if required.
8. Patching, smoothing, and leveling, as required.
9. Other preparation specified.
10. Adhesive bond and compatibility test.
11. Protection.

B. Remediations:

1. Active Water Leaks or Continuing Moisture Migration to Surface of Slab: Correct this condition before doing any other remediation; re-test after correction.
2. Excessive Moisture Emission or Relative Humidity: If an adhesive that is resistant to the level of moisture present is available and acceptable to flooring manufacturer, use that adhesive for installation of the flooring; if not, apply remedial floor coating over entire suspect floor area.
3. Excessive pH: If remedial floor coating is necessary to address excessive moisture, no additional remediation is required; if not, if an adhesive that is resistant to the level present is available and acceptable to the flooring manufacturer, use that adhesive for installation of the flooring; otherwise, apply a skim coat of specified patching compound over entire suspect floor area.

3.2 PRELIMINARY CLEANING

A. Clean floors of dust, solvents, paint, wax, oil, grease, asphalt, residual adhesive, adhesive removers, film-forming curing compounds, sealing compounds, alkaline salts, excessive laitance, mold, mildew, and other materials that might prevent adhesive bond.

B. Do not use solvents or other chemicals for cleaning.

3.3 MOISTURE VAPOR EMISSION TESTING

A. Where the floor covering manufacturer's requirements conflict with either the referenced test method or this specification, comply with the manufacturer's requirements.

B. Where this specification conflicts with the referenced test method, comply with the requirements of this section.

C. Test in accordance with ASTM F1869 and as follows.

D. Plastic sheet test and mat bond test may not be substituted for the specified ASTM test method, as those methods do not quantify the moisture content sufficiently.

E. In the event that test values exceed floor covering manufacturer's limits, perform remediation as indicated. In the absence of manufacturer limits, perform remediation if test values exceed 3 pounds per 1000 square feet per 24 hours.

F. Report: Report the information required by the test method.

3.4 INTERNAL RELATIVE HUMIDITY TESTING

A. Where the floor covering manufacturer's requirements conflict with either the referenced test method or this specification, comply with the manufacturer's requirements.

B. Where this specification conflicts with the referenced test method, comply with the requirements of this section.

C. Test in accordance with ASTM F2170 Procedure A and as follows.

D. Testing with electrical impedance or resistance apparatus may not be substituted for the specified ASTM test method, as the values determined are not comparable to the ASTM test values and do not quantify the moisture content sufficiently.

E. In the event that test values exceed floor covering manufacturer's limits, perform remediation as indicated. In the absence of manufacturer limits, perform remediation if any test value exceeds 75 percent relative humidity.

F. Report: Report the information required by the test method.

3.5 PH TESTING

A. Where the floor covering manufacturer's requirements conflict with either the referenced test method or this specification, comply with the manufacturer's requirements.

B. Note: This procedure is the equivalent of that described in ASTM F710, repeated here for the Contractor's convenience.

C. Use a wide range pH paper, its associated chart, and distilled or deionized water.

D. Place several drops of water on a clean surface of concrete, forming a puddle approximately 1 inch in diameter. Allow the puddle to set for approximately 60 seconds, then dip the pH paper into the water, remove it, and compare immediately to chart to determine pH reading.

E. E. In the event that test values exceed floor covering manufacturer's limits, perform remediation as indicated. In the absence of manufacturer limits, perform remediation if any test value is over 10.

3.6 PREPARATION

A. See individual floor covering section(s) for additional requirements.

B. Comply with recommendations of testing agency.

C. Comply with requirements and recommendations of floor covering manufacturer.

D. Fill and smooth surface cracks, grooves, depressions, control joints and other non-moving joints, and other irregularities with patching compound.

E. Do not fill expansion joints, isolation joints, or other moving joints.

3.7 ADHESIVE BOND AND COMPATIBILITY TESTING

A. Comply with requirements and recommendations of floor covering manufacturer.

3.8 APPLICATION OF REMEDIAL FLOOR COATING

A. When required, comply with requirements and recommendations of coating manufacturer.

3.9 PROTECTION

A. Cover prepared floors with building paper or other durable covering.

END OF SECTION

SECTION 092216 - NON-STRUCTURAL METAL FRAMING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Non-load-bearing steel framing systems for interior gypsum board assemblies.
2. Suspension systems for interior gypsum ceilings and soffits.
3. Grid suspension system for gypsum board ceilings.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.3 INFORMATIONAL SUBMITTALS

A. Evaluation Reports: For Equivalent Gage Thickness studs and runners, from ICC-ES.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Products: Subject to compliance with requirements, provide products by one of the following:

1. CEMCO, www.cemcosteel.com.
2. ClarkDietrich Metal Framing; www.clarkdietrich.com.
3. MarinoWare; www.marinoware.com.
4. SCAFCO Corporation; www.scafco.com.

2.2 PERFORMANCE REQUIREMENTS

A. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated, according to ASTM E 90 and classified according to ASTM E 413 by an independent testing agency.

2.3 FRAMING SYSTEMS

A. Framing Members, General: Comply with ASTM C 754 for conditions indicated.

1. Steel Sheet Components: Comply with ASTM C 645 requirements for metal unless otherwise indicated.
2. Protective Coating: ASTM A 653/A 653M, G60, hot-dip galvanized unless otherwise indicated.

B. Studs and Runners: ASTM C 645. Use either Steel Studs and Runners or Equivalent Gage Thickness Steel Studs and Runners.

1. Steel Studs and Runners:

a. Minimum Base-Metal Thickness: 0.015 inch (25 gage) typical, 0.019 inch (20 gage) supporting tile, masonry, or plaster finishes; increase thickness as necessary to meet limiting height deflecton criteria for the stud depths indicated on the Drawings.
b. Depth: As indicated on Drawings; do not change depth to meet limiting height deflection criteria without approval of Architect.

2. Equivalent Gage Thickness Steel Studs and Runners: Members that can show certified third party testing with gypsum board in accordance with ICC ES need not meet the minimum thickness limitation or minimum section properties set forth in ASTM C645. The submission of an evaluation report is acceptable to show conformance to this requirement.
   a. Products: Subject to compliance with requirements, provide one of the following:
      1) ProStud Drywall Framing System.
      2) ViperStud Drywall Framing System.

C. Slip-Type Head Joints: Where indicated, provide one of the following:

1. Single Long-Leg Runner System: ASTM C 645 top runner with 2-1/2-inch- deep flanges in thickness not less than indicated for studs, installed with studs friction fit into top runner and with continuous bridging located within 12 inches of the top of studs to provide lateral bracing.
2. Double-Runner System: ASTM C 645 top runners, inside runner with 2-1/2-inch- deep flanges fastened to studs, and outer runner sized to friction fit inside runner, in thickness not less than indicated for studs.
3. Slotted Deflection Track: Slotted steel sheet top runner with 2 1/2 inch deep flanges in thickness not less than indicated for studs and in width to accommodate depth of studs.
   a. Products: Subject to compliance with requirements, provide one of the following:
      1) ClarkDietrich Building Systems; MaxTrak Slotted Deflection Track.
      2) MarinoWare; Slotted Track.

D. Flat Strap and Backing Plate: Steel sheet for blocking and bracing in length and width indicated.

1. Minimum Base-Metal Thickness: 0.033 inch (16 gage).

E. Cold-Rolled Channel Bridging: Steel, 0.053-inch minimum base-metal thickness, with minimum 1/2-inch- wide flanges.

1. Depth: 1-1/2 inches.
2. Clip Angle: Not less than 1-1/2 by 1-1/2 inches, 0.068-inch- thick, galvanized steel.

F. Hat-Shaped, Rigid Furring Channels: ASTM C 645.

1. Minimum Base-Metal Thickness: 0.018 inch (20 gage).
2. Depth: 7/8 inch.

G. Resilient Furring Channels: 1/2-inch- deep steel sheet members designed to reduce sound transmission.

1. Configuration: Asymmetrical or hat shaped.

H. Cold-Rolled Furring Channels: 0.053-inch uncoated-steel thickness, with minimum 1/2-inch-wide flanges.

1. Depth: 3/4 inch.
2. Furring Brackets: Adjustable, corrugated-edge type of steel sheet with minimum uncoated-steel thickness of 0.033 inch.

3. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.062-inch- diameter wire, or double strand of 0.048-inch- diameter wire.

I. Z-Shaped Furring: With slotted or nonslotted web, face flange of 1-1/4 inches, wall attachment flange of 7/8 inch, minimum uncoated-metal thickness of 0.018 inch (20 gage), and depth required to fit insulation thickness indicated.

2.4 SUSPENSION SYSTEMS

A. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.062-inch- diameter wire, or double strand of 0.048-inch- diameter wire.

B. Hanger Attachments to Concrete:

1. Anchors: Fabricated from corrosion-resistant materials with holes or loops for attaching wire hangers and capable of sustaining, without failure, a load equal to 5 times that imposed by construction as determined by testing according to ASTM E 488 by an independent testing agency.
   a. Type: Postinstalled, expansion anchor.

2. Powder-Actuated Fasteners: Suitable for application indicated, fabricated from corrosion-resistant materials with clips or other devices for attaching hangers of type indicated, and capable of sustaining, without failure, a load equal to 10 times that imposed by construction as determined by testing according to ASTM E 1190 by an independent testing agency.

C. Wire Hangers: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.16 inch in diameter.

D. Carrying Channels: Cold-rolled, commercial-steel sheet with a base-metal thickness of 0.053 inch and minimum 1/2-inch- wide flanges.

1. Depth: As indicated on Drawings.

E. Furring Channels (Furring Members):

1. Cold-Rolled Channels: 0.053-inch uncoated-steel thickness, with minimum 1/2-inch-wide flanges, 3/4 inch deep.
2. Steel Studs and Runners: ASTM C 645. Use either steel studs and runners or Equivalent Gage Thickness steel studs and runners as specified for framing systems.
3. Hat-Shaped, Rigid Furring Channels: ASTM C 645, 7/8 inch deep.
   a. Minimum Base-Metal Thickness: 0.018 inch (20 gage).

4. Resilient Furring Channels: 1/2-inch- deep members designed to reduce sound transmission.
   a. Configuration: Asymmetrical or hat shaped.

F. Grid Suspension System for Gypsum Board Ceilings: ASTM C 645, direct-hung system composed of main beams and cross-furring members that interlock.

1. Products: Subject to compliance with requirements, provide one of the following:
   a. Armstrong World Industries, Inc.; Drywall Grid Systems.
   b. Rockfon; Chicago Metallic 640/660 Drywall Grid System.
   c. USG Corporation; Drywall Suspension System.

2.5 AUXILIARY MATERIALS

A. General: Provide auxiliary materials that comply with referenced installation standards.

1. Fasteners for Metal Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.

B. Isolation Strip at Acoustical Walls: Molded, low-density fiberglass board for continuous installation under base track and over head track at indicated acoustical partitions; designed to support continuous loads of up to 25 psi without excessive creep or pad failure; 1/2 inch thick.

1. Products: Subject to compliance with requirements, provide Wallmat as manufactured by Kinetics Noise Control, Inc., or comparabe product by an alternate manufacturer.

C. Isolation Bushings at Acoustical Walls: 60 durometer rubber bushing with steel spacer and washer for use with 1/4 inch dia anchors securing base and head tracks of indicated acoustical partitions; 1/2 inch thick.

1. Products: Subject to compliance with requirements, provide Model KAI-S as manufactured by Kinetics Noise Control, Inc., or comparable product by an alternate manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and substrates, with Installer present, and including welded hollow-metal frames, cast-in anchors, and structural framing, for compliance with requirements and other conditions affecting performance of the Work.

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

3.2 PREPARATION

A. Suspended Assemblies: Coordinate installation of suspension systems with installation of overhead structure to ensure that inserts and other provisions for anchorages to building structure have been installed to receive hangers at spacing required to support the Work and that hangers will develop their full strength.

1. Furnish concrete inserts and other devices indicated to other trades for installation in advance of time needed for coordination and construction.

3.3 INSTALLATION, GENERAL

A. Installation Standard: ASTM C 754.

1. Portland Cement Plaster Assemblies: Also comply with requirements in ASTM C 1063 that apply to framing installation.
2. Gypsum Board Assemblies: Also comply with requirements in ASTM C 840 that apply to framing installation.

B. Install supplementary framing, and blocking to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction.

C. Install bracing at terminations in assemblies.

D. Do not bridge building control and expansion joints with non-load-bearing steel framing members. Frame both sides of joints independently.

3.4 INSTALLING FRAMED ASSEMBLIES

A. Install framing system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.

1. Single-Layer Application: 16 inches o.c. unless otherwise indicated.
2. Multilayer Application: 16 inches o.c. unless otherwise indicated.
3. Tile Backing Panels: 12 inches o.c. unless otherwise indicated.

B. Install studs so flanges within framing system point in same direction.

C. Install tracks (runners) at floors and overhead supports. Extend framing full height to structural supports or substrates above suspended ceilings except where partitions are indicated to terminate at suspended ceilings. Continue framing around ducts penetrating partitions above ceiling.

1. Slip-Type Head Joints: Where framing extends to overhead structural supports, install to produce joints at tops of framing systems that prevent axial loading of finished assemblies.
2. Door Openings: Screw vertical studs at jambs to jamb anchor clips on door frames; install runner track section (for cripple studs) at head and secure to jamb studs.
   a. Install two studs at each jamb unless otherwise indicated.
   b. Install cripple studs at head adjacent to each jamb stud, with a minimum 1/2-inch clearance from jamb stud to allow for installation of control joint in finished assembly.
   c. Extend jamb studs through suspended ceilings and attach to underside of overhead structure.
3. Other Framed Openings: Frame openings other than door openings the same as required for door openings unless otherwise indicated. Install framing below sills of openings to match framing required above door heads.
4. Sound-Rated Partitions: Install framing to comply with sound-rated assembly indicated. In addition, at indicated acoustical partitions, install the following in accordance with manufacturer'¢s instructions:
   a. Isolation strips continuously under base track and over head track.
   b. Isolaton bushings at each base and head track fastener.
5. Curved Partitions:
   a. Bend track to uniform curve and locate straight lengths so they are tangent to arcs.
   b. Begin and end each arc with a stud, and space intermediate studs equally along arcs. On straight lengths of no fewer than two studs at ends of arcs, place studs 6 inches o.c.

D. Direct Furring:

1. Screw to wood framing.
2. Attach to concrete or masonry with stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches o.c.

E. Z-Furring Members:

1. Erect insulation, specified in Section 072100 "Thermal Insulation," vertically and hold in place with Z-furring members spaced 24 inches o.c.
2. Except at exterior corners, securely attach narrow flanges of furring members to wall with concrete stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches o.c.

3. At exterior corners, attach wide flange of furring members to wall with short flange extending beyond corner; on adjacent wall surface, screw-attach short flange of furring channel to web of attached channel. At interior corners, space second member no more than 12 inches from corner and cut insulation to fit.

F. Installation Tolerance: Install each framing member so fastening surfaces vary not more than 1/8 inch from the plane formed by faces of adjacent framing.

3.5 INSTALLING SUSPENSION SYSTEMS

A. Install suspension system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.

1. Hangers: 48 inches o.c.
2. Carrying Channels (Main Runners): 48 inches o.c.
3. Furring Channels (Furring Members): 16 inches o.c.

B. Isolate suspension systems from building structure where they abut or are penetrated by building structure to prevent transfer of loading imposed by structural movement.

C. Suspend hangers from building structure as follows:

1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structural or suspension system.
   a. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.

2. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with locations of hangers required to support standard suspension system members, install supplemental suspension members and hangers in the form of trapezes or equivalent devices.
   a. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced installation standards.

3. Wire Hangers: Secure by looping and wire tying, either directly to structures or to inserts, eye screws, or other devices and fasteners that are secure and appropriate for substrate, and in a manner that will not cause hangers to deteriorate or otherwise fail.
4. Do not attach hangers to permanent metal forms. Furnish cast-in-place hanger inserts that extend through forms.
5. Do not connect or suspend steel framing from ducts, pipes, or conduit.

D. Grid Suspension Systems: Attach perimeter wall track or angle where grid suspension systems meet vertical surfaces. Mechanically join main beam and cross-furring members to each other and butt-cut to fit into wall track.

E. Installation Tolerances: Install suspension systems that are level to within 1/8 inch in 12 feet measured lengthwise on each member that will receive finishes and transversely between parallel members that will receive finishes.

END OF SECTION

SECTION 092900 - GYPSUM BOARD

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Interior gypsum board.
2. Acoustical insulation for sound rated partitions.

B. Related Requirements:

1. Section 092216 "Non-Structural Metal Framing" for non-structural framing and suspension systems that support gypsum board panels.
2. Section 093000 "Tiling" for tile backing panels installed as substrates for ceramic tile.
3. Section 099000 “Painting and Coating” for primers applied to gypsum board surfaces.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.3 QUALITY ASSURANCE

A. Mockups: Before beginning gypsum board installation, install mockups of at least 100 sq. ft. in surface area to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Install mockups for the following:
   a. Each level of gypsum board finish indicated for use in exposed locations.
   b. Each texture finish indicated.
2. Apply or install final decoration indicated, including painting and wallcoverings, on exposed surfaces for review of mockups.
3. Simulate finished lighting conditions for review of mockups.
4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

B. Interior gypsum wallboard and ceiling board installation may not commence until all exterior dampproofing and roofing are completed and roof top equipment is fully installed, flashed and in operation, and exterior wall openings are protected (close-in).

1.4 DELIVERY, STORAGE AND HANDLING

A. Store materials inside under cover and keep them dry and protected against weather, condensation, direct sunlight, construction traffic, and other potential causes of damage. Stack panels flat and supported on risers on a flat platform to prevent sagging.

1.5 FIELD CONDITIONS

A. Environmental Limitations: Comply with ASTM C 840 requirements or gypsum board manufacturer's written recommendations, whichever are more stringent.

B. Do not install paper-faced gypsum panels until installation areas are enclosed and conditioned.

C. Do not install panels that are wet, those that are moisture damaged, and those that are mold damaged.

1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing agency.

B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 90 and classified according to ASTM E 413 by an independent testing agency.

2.2 GYPSUM BOARD, GENERAL

A. Size: Provide maximum lengths and widths available that will minimize joints in each area and that correspond with support system indicated.

2.3 INTERIOR GYPSUM BOARD

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

1. CertainTeed Corp.
2. Georgia-Pacific Gypsum LLC.
3. National Gypsum Company.
4. USG Corporation.

B. Gypsum Board, Type X: ASTM C 1396/C 1396M.

1. Thickness: 5/8 inch.
2. Long Edges: Tapered.

C. Moisture- and Mold-Resistant Gypsum Board: ASTM C 1396/C 1396M. With moisture- and mold-resistant core and paper surfaces.

1. Core: 5/8 inch, Type X.
2. Long Edges: Tapered.
3. Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274.

2.4 SPECIALTY GYPSUM BOARD

A. Glass-Mat Interior Gypsum Board: ASTM C 1658/C 1658M. With fiberglass mat laminated to both sides. Specifically designed for interior use.

1. Products: Subject to compliance with requirements, provide the following:
   a. Georgia-Pacific Gypsum LLC; DensArmour Plus.
2. Core: 5/8 inch, Type X.
3. Long Edges: Tapered.
4. Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274.

B. Tile Backing Panels: As specified in Section 093000 "Tiling."

2.5 TRIM ACCESSORIES

A. Interior Trim: ASTM C 1047.

1. Material: Galvanized or aluminum-coated steel sheet or rolled zinc.
2. Shapes:
   a. Cornerbead.
   b. Bullnose bead.
   c. LC-Bead: J-shaped; exposed long flange receives joint compound.
   d. L-Bead: L-shaped; exposed long flange receives joint compound.
   e. U-Bead: J-shaped; exposed short flange does not receive joint compound.
   f. Expansion (control) joint.
   g. Curved-Edge Cornerbead: With notched or flexible flanges.

B. Aluminum Trim: Extruded accessories of profiles and dimensions indicated.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Fry Reglet Corp.
   b. Gordon, Inc.
   c. Pittcon Industries.
2. Aluminum: Alloy and temper with not less than the strength and durability properties of ASTM B 221, Alloy 6063-T5.
3. Embedded Trim Finish: Corrosion-resistant primer compatible with joint compound and finish materials specified.
4. Exposed Trim Finish: Class II clear anodized.

2.6 JOINT TREATMENT MATERIALS

A. General: Comply with ASTM C 475/C 475M.

B. Joint Tape:

1. Interior Gypsum Board: Paper.
2. Glass-Mat Gypsum Sheathing Board: 10-by-10 glass mesh.

C. Joint Compound for Interior Gypsum Board: For each coat use formulation that is compatible with other compounds applied on previous or for successive coats.

1. Prefilling: At open joints and damaged surface areas, use setting-type taping compound.
2. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use drying-type, all-purpose compound.
3. Fill Coat: For second coat, use drying-type, all-purpose compound.
4. Finish Coat: For third coat, use drying-type, all-purpose compound.

5. Skim Coat: For final coat of Level 5 finish, use high-build interior coating product designed for application by airless sprayer and to be used instead of skim coat to produce Level 5 finish.

2.7 AUXILIARY MATERIALS

A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written recommendations.

B. Steel Drill Screws: ASTM C 1002, unless otherwise indicated.

1. Use screws complying with ASTM C 954 for fastening panels to steel members from 0.033 to 0.112 inch thick.
2. For fastening cementitious backer units, use screws of type and size recommended by panel manufacturer.

C. Acoustical Insulation: ASTM C 665, Type I; preformed batt; friction fit, for interior walls, conforming to the following:

1. Material: Inorganic Glass Fiber with acrylic resin binder or Mineral Wool
2. Flame Spread Index: 25 or less, when tested in accordance with ASTM E 84.
3. Smoke Developed Index: 450 or less, when tested in accordance with ASTM E 84.
4. Acoustical Performance:
   a. NRC: 1.05 for 3.5 inch thickness.
   b. STC: 49 minimum, installed in 3-5/8 metal stud wall with 5/8 inch gypsum board on each side.
5. Facing: Unfaced.
6. Manufacturers:
   a. CertainTeed Corporation; CertaPro AcoustaTherm: www.certainteed.com.
   b. Johns Manville Corporation; Sound Control Batts: www.jm.com.
   c. Knauf Insulation; QueitTherm QT: www.knaufinsulation.us.
   d. Owens Corning Corp; QuietZone Acoustic Batts: www.owenscorning.com
   e. Thermafiber SAFB: www.thermafiber.com

D. Thermal Insulation: As specified in Section 072100 "Thermal Insulation."

E. Acoustical Joint Sealant: As specified in Section 079200 “Joint Sealants.”

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and substrates including welded hollow-metal frames and framing, with Installer present, for compliance with requirements and other conditions affecting performance.

B. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.

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

3.2 APPLYING AND FINISHING PANELS, GENERAL

A. Comply with ASTM C 840.

B. Install ceiling panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.

C. Install panels with face side out. Butt panels together for a light contact at edges and ends with not more than 1/16 inch of open space between panels. Do not force into place.

D. Locate edge and end joints over supports, except in ceiling applications where intermediate supports or gypsum board back-blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of framed openings.

E. Form control and expansion joints with space between edges of adjoining gypsum panels.

F. Cover both faces of support framing with gypsum panels in concealed spaces (above ceilings, etc.), except in chases braced internally.

1. Unless concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than 8 sq. ft. in area.
2. Fit gypsum panels around ducts, pipes, and conduits.
3. Where partitions intersect structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by structural members; allow 1/4- to 3/8-inch- wide joints to install sealant.

G. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments, except floors. Provide 1/4- to 1/2-inch- wide spaces at these locations and trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.

H. Attachment to Steel Framing: Attach panels so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.

I. STC-Rated Assemblies: Seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical sealant. Install acoustical sealant at both faces of partitions at perimeters and through penetrations. Comply with ASTM C 919 and with manufacturer's written recommendations for locating edge trim and closing off sound-flanking paths around or through assemblies, including sealing partitions above acoustical ceilings.

J. Install sound attenuation blankets before installing gypsum panels unless blankets are readily installed after panels have been installed on one side.

3.3 APPLYING INTERIOR GYPSUM BOARD

A. Install interior gypsum board in the following locations:

1. Type X: Typical, unless noted otherwise.
2. Moisture- and Mold-Resistant Type: As indicated on Drawings.
3. Glass-Mat Interior Type: At interior side of exterior walls.

B. Single-Layer Application:

1. On ceilings, apply gypsum panels before wall/partition board application to greatest extent possible and at right angles to framing unless otherwise indicated.

2. On partitions/walls, apply gypsum panels horizontally or vertically (parallel to framing) unless otherwise indicated or required by fire-resistance-rated assembly, and minimize end joints.
   a. Stagger abutting end joints not less than one framing member in alternate courses of panels.
   b. At stairwells and other high walls, install panels horizontally unless otherwise indicated or required by fire-resistance-rated assembly.
3. On Z-furring members, apply gypsum panels vertically (parallel to framing) with no end joints. Locate edge joints over furring members.
4. Fastening Methods: Apply gypsum panels to supports with steel drill screws.

C. Multilayer Application:

1. On ceilings, apply gypsum board indicated for base layers before applying base layers on walls/partitions; apply face layers in same sequence. Apply base layers at right angles to framing members and offset face-layer joints one framing member, 16 inches minimum, from parallel base-layer joints, unless otherwise indicated or required by fire-resistance-rated assembly.
2. On partitions/walls, apply gypsum board indicated for base layers and face layers vertically (parallel to framing) with joints of base layers located over stud or furring member and face-layer joints offset at least one stud or furring member with base-layer joints unless otherwise indicated or required by fire-resistance-rated assembly. Stagger joints on opposite sides of partitions.
3. On Z-shaped furring members, apply base layer vertically (parallel to framing) and face layer either vertically (parallel to framing) or horizontally (perpendicular to framing) with vertical joints offset at least one furring member. Locate edge joints of base layer over furring members.
4. Fastening Methods: Fasten base layers and face layers separately to supports with screws.

D. Laminating to Substrate: Where gypsum panels are indicated as directly adhered to a substrate (other than studs, joists, furring members, or base layer of gypsum board), comply with gypsum board manufacturer's written instructions and temporarily brace or fasten gypsum panels until fastening adhesive has set.

3.4 APPLYING TILE BACKING PANELS

A. Refer to Division 9 Section Tiling for board installation.

3.5 INSTALLING TRIM ACCESSORIES

A. General: For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.

B. Control Joints: Install control joints according to ASTM C 840 and in specific locations approved by Architect for visual effect.

C. Interior Trim: Install in the following locations:

1. Cornerbead: Use at outside corners.
2. LC-Bead: Use at exposed panel edges.
3. L-Bead: Use where indicated.
4. U-Bead: Use where indicated.
5. Curved-Edge Cornerbead: Use at curved openings.

D. Aluminum Trim: Install in locations indicated on Drawings.

3.6 FINISHING GYPSUM BOARD

A. General: Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.

B. Apply joint tape over gypsum board joints, except for trim products specifically indicated as not intended to receive tape.

C. Gypsum Board Finish Levels: Finish panels to levels indicated below and according to ASTM C 840:

1. Level 1: Ceiling plenum areas, concealed areas, and where indicated.
2. Level 4: At panel surfaces that will be exposed to view unless otherwise indicated.
3. Level 5: Where indicated on Drawings.

3.7 PROTECTION

A. Protect adjacent surfaces from drywall compound and promptly remove from floors and other non-drywall surfaces. Repair surfaces stained, marred, or otherwise damaged during drywall application.

B. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.

C. Remove and replace panels that are wet, moisture damaged, and mold damaged.

1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION

SECTION 093000 - TILING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Interior floor tile.
2. Interior wall tile.
3. Crack isolation membrane.
4. Tile backing panels.
5. Metal edge and corner strips.

B. Related Requirements:

1. Section 079200 “Joint Sealants.”
2. Section 090561 "Common Work Results for Flooring Preparation" for testing and preparation of concrete substrates.

1.2 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Convene a preinstallation meeting one week before starting work of this section; require attendance by all affected installers.

1.3 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide manufacturers' data sheets on tile, mortar, grout, and accessories. Include instructions for using grouts and adhesives.

C. Samples: Mount tile and apply grout on two plywood panels, minimum 18 x 18 inches in size illustrating pattern, color variations, and grout joint size variations.

D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

E. Maintenance Data: Include recommended cleaning methods, cleaning materials, stain removal methods, and polishes and waxes.

1.4 QUALITY ASSURANCE

A. Maintain one copy of TCNA Handbook and ANSI A108 Series/A118 Series on site.

B. Manufacturer Qualifications: Company specializing in manufacturing the types of products specified in this section, with minimum 5 years of documented experience.

C. Installer Qualifications: Company specializing in performing tile installation, with minimum of 5 years of documented experience.

1.5 MOCK-UP

A. See Section 014000 - Quality Requirements, for general requirements for mock-up.

B. Construct final tile mock-ups in location directed by Architect, incorporating all components specified for the location.

1. Minimum size of mock-up 48 inches by 48 inches for each pattern.
2. Approved mock-up may remain as part of the Work.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver and store packaged materials in original containers with seals unbroken and labels intact until time of use.

B. Store tile and cementitious materials on elevated platforms, under cover, and in a dry location.

C. Store liquid materials in unopened containers and protected from freezing.

1.7 PROJECT CONDITIONS

A. Environmental Limitations: Do not install tile until construction in spaces is complete and ambient temperature and humidity conditions are maintained at the levels indicated in referenced standards and manufacturer's written instructions.

1.8 SEQUENCING AND SCHEDULING

A. Sequence tile installation with other work to minimize possibility of damage and soiling during remainder of construction period.

PART 2 - PRODUCTS

2.1 TILE PRODUCTS

A. Refer to Finish Schedule on Drawings for tile types.

2.2 TILE BACKING PANELS

A. Backing Board for Dry Areas and for walls behind and adjacent to sinks without tile:

1. Glass Mat Interior Gypsum Board: ASTM C 1658/C 1658M, C 1177/C 1177M; fiber reinforced gypsum core with glass mat faces.
2. Thickness: 5/8 inch.
3. Core: Type X.
4. Edges: Tapered.
5. Basis-of-Design: Subject to compliance with requirements, provide DensArmor Plus Interior Panel by Georgia-Pacific Gypsum LLC.

B. Backing Board for Wet Areas: One of the following products, at Contractor's option:

1. Cementitious Backing Unit: ANSI A118.9 or ASTM C 1325, Type A; aggregated portland cement panels with glass fiber mesh embedded in front and back surfaces.

a. Thickness: 5/8 inch.
b. Edges: Square.
c. Products: Subject to compliance with requirements, provide one of the following:
   1) Custom Building Products; Wonderboard Lite.
   2) National Gypsum Company; PermaBase Cement Board.
   3) USG Corporation; Durock Cement Board.

2. Coated Glass Mat Water-Resistant Gypsum Backing Board: ASTM C 1178/C 1178M; Water-resistant gypsum core with coated glass mat faces.
   a. Thickness: 5/8 inch.
   b. Edges: Square.
   c. Basis-of-Design: Subject to compliance with requirements, provide DensShield Tile Backer by Georgia-Pacific Gypsum LLC.

C. Mesh Tape: 2-inch wide self-adhesive fiberglass mesh tape.

2.3 SETTING MATERIALS

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

1. Custom Building Products.
2. Laticrete International, Inc.
3. MAPEI Corporation.

B. Modified Dry-Set Mortar (Thin Set): ANSI A118.4 and ISO 13007 C2S1P1

1. Provide prepackaged, dry-mortar mix containing dry, redispersible, vinyl acetate or acrylic additive to which only water must be added at Project site.
2. For wall applications, provide mortar that complies with requirements for nonsagging mortar per ANSI A118.4T and ISO 13007 C2TS1P1.

2.4 GROUT MATERIALS

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

1. Custom Building Products.
2. Laticrete International, Inc.
3. MAPEI Corporation.

B. Polymer-Modified Tile Grout: ANSI A118.7 and ISO 13007 CG2WAF.

1. Polymer Type: Ethylene vinyl acetate or acrylic additive, in dry, redispersible form, prepackaged with other dry ingredients.
2. Provide sanded grout at joints 1/16 inch wide or wider.

2.5 ACCESSORY MATERIALS

A. Trowelable Leveling and Patching Compounds: As specified in Section 090561 "Common Work Results for Flooring Preparation."

B. Crack Isolation Membrane: Reinforced membrane complying with ANSI A118.12 for high performance. Include adhesives and accessories recommended by manufacturer:

1. Mapei Corporation; Mapeguard 2.

2. Noble Company; NobleSeal CIS.
3. National Applied Construction Products; ECB Classic.

C. Metal Edge Trim: Angle or L-shaped, height to match tile and setting-bed thickness, designed specifically for tiling applications; satin anodized aluminum exposed-edge material.

1. Basis-of-Design Product: Schluter Systems trim, of the following types:
   a. Perimeter and corner wall trim: JOLLY.
   b. Floor transitions: RENO U.

D. Tile Cleaner: A neutral cleaner capable of removing soil and residue without harming tile and grout surfaces, specifically approved for materials and installations indicated by tile and grout manufacturers.

E. Floor Sealer: Manufacturer's standard product for sealing grout joints and that does not change color or appearance of grout.

2.6 ELASTOMERIC SEALANTS

A. General: Provide sealants, primers, backer rods, and other sealant accessories in accordance with Section 079200 "Joint Sealants."

B. Products: Subject to compliance with requirements, provide one of the following:

1. Mapei Corporation, Mapesil T.
2. Laticrete International, Latasil.
3. Custom Building Products, 100% Silicone Calk.

C. Colors: Provide colors of exposed sealants to match colors of grout in tile adjoining sealed joints unless otherwise indicated.

2.7 MIXING MORTARS AND GROUT

A. Mix mortars and grouts to comply with referenced standards and mortar and grout manufacturers' written instructions.

B. Add materials, water, and additives in accurate proportions.

C. Obtain and use type of mixing equipment, mixer speeds, mixing containers, mixing time, and other procedures to produce mortars and grouts of uniform quality with optimum performance characteristics for installations indicated.

PART 3 - EXECUTION

3.1 PREPARATION

A. Prepare and test concrete substrates in accordance with Section 090561 "Common Work Results for Flooring Preparation" and the following:

1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
2. Remove substrate coatings and other substances that are incompatible with setting materials, using mechanical methods recommended by setting material manufacturer.
3. Verify that substrate alkalinity falls within range on pH scale recommended by setting material manufacturer, but not less than 5 or more than 9 pH.

4. Verify that substrate moisture vapor emission and internal relative humidity values are withinn setting material manufacturer's written recommendations.
5. Fill cracks, holes, and depressions in substrates and remove bumps and ridges to produce a uniform and smooth substrate.

B. Install tile backer board in accordance with Section 092900 "Gypsum Board." Tape joints and corners; bed in material used to set tiles.

1. At wet areas, apply silicone sealant to corners and board joints prior to taping.

C. Prepare substrate surfaces for adhesive installation in accordance with adhesive manufacturer's instructions.

D. Verify that required utilities are in correct locations.

3.2 INSTALLATION - GENERAL

A. Comply with TCNA's "Handbook for Ceramic, Glass, and Stone Tile Installation" for TCNA installation methods specified. Comply with parts of the ANSI A108 series "Specifications for Installation of Ceramic Tile" that are referenced in TCNA installation methods, specified in tile installation schedules, and apply to types of setting and grouting materials used.

B. For the following installations, follow procedures in the ANSI A108 series of tile installation standards for providing 95 percent mortar coverage:

1. Exterior tile floors.
2. Tile floors in wet areas.
3. Tile floors consisting of tiles 8 by 8 inches or larger.

C. Request tile pattern if not indicated. Do not interrupt tile pattern through openings.

D. Cut and fit tile to penetrations through tile, leaving sealant joint space. Form corners and bases neatly. Align floor, base, and wall joints.

E. Place tile joints uniform in width, subject to variance in tolerance allowed in tile size. Make joints watertight, without voids, cracks, excess mortar, or excess grout.

F. Form internal angles square and external angles bullnosed.

G. Sound tile after setting. Replace hollow sounding units.

H. Where shown or required, provide expansion joints over concrete expansion joints, construction over concrete cold joints, and perimeter joints in accordance with TCNA Handbook Method EJ171. Apply sealant and back-up to joints.

I. Keep control joints free of adhesive or grout. Apply sealant to joints.

J. Allow tile to set for a minimum of 48 hours prior to grouting.

K. Grout tile joints. Use standard grout unless otherwise indicated.

L. Apply sealant to junction of tile and dissimilar materials and junction of dissimilar planes.

M. Jointing Pattern: Lay tile in grid pattern unless otherwise indicated. Lay out tile work and center tile fields in both directions in each space or on each wall area. Lay out tile work to minimize the use of pieces that are less than half of a tile. Provide uniform joint widths unless otherwise indicated.

1. For tile mounted in sheets, make joints between tile sheets same width as joints within tile sheets so joints between sheets are not apparent in finished work.
2. Where adjoining tiles on floor, base, walls, or trim are specified or indicated to be same size, align joints.
3. Where tiles are specified or indicated to be whole integer multiples of adjoining tiles on floor, base, walls, or trim, align joints unless otherwise indicated.

N. Joint Widths: Unless otherwise indicated, install tile with the following joint widths:

1. Ceramic Mosaic Tile: 1/16 inch.
2. Quarry Tile: 1/4 inch 6.4 mm.
3. Porcelain Tile: 1/8 inch.
4. Glazed Wall Tile: 1/16 inch.

O. Expansion Joints: Provide expansion joints and other sealant-filled joints, including control, contraction, and isolation joints, where indicated. Form joints during installation of setting materials, mortar beds, and tile. Do not saw-cut joints after installing tiles.

1. Where joints occur in concrete substrates, locate joints in tile surfaces directly above them.
2. Where shown or required, provide expansion joints over concrete expansion joints, construction over concrete cold joints, and perimeter joints in accordance with TCNA Handbook Method EJ171. Apply sealant and back-up to joints.

P. Metal Edge Strips: Install at exposed edges of tile and where tile meets carpet, wood, or other materials.

3.3 CRACK ISOLATION MEMBRANE INSTALLATION

A. Install crack isolation membrane in accordance with TCNA Handbook Method F125 and manufacturer's instructions.

B. Do not install tile or setting materials over crack isolation membrane until membrane has cured.

3.4 TILE BACKING PANEL INSTALLATION

A. Install backer units and treat joints according to ANSI A108.11 and manufacturer's written instructions for type of application indicated.

3.5 INSTALLATION - INTERIOR FLOORS

A. Concrete floors with thinset mortar.

1. Installation Method without Waterproofing: TCNA F113/F113A.
2. Install crack isolation membrane over concrete slabs not receiving waterproofing membrane.
3. Bond Coat: Thinset mortar.
4. Grout: Polymer modified grout.

3.6 INSTALLATION - INTERIOR WALLS

A. Thinset mortar on tile backer board.

1. Installation Method:
   a. TCNA W244C over cementitious backer units.
   b. TCNA W245 over glass mat gypsum backer board.
2. Mortar: Thinset mortar.
3. Grout: Polymer modified grout.

3.7 INSTALLATION TOLERANCES

A. Variation from Plumb: For vertical joints, external corners, and other conspicuous lines, do not exceed 1/8 inch in 8 feet.

B. Variation in Level: For horizontal joints and other conspicuous lines, do not exceed 1/8 inch in 10 feet, or 1/2 inch maximum.

C. Variation in Surface Plane of Flooring: Do not exceed 1/8 inch in 10 feet from level or slope indicated when tested with a 10-foot straightedge.

D. Variation in Plane between Adjacent Units (Lipping): Do not exceed the following differences between faces of adjacent units as measured from a straightedge parallel to stone tiled surface:

1. Units with Polished Faces: 1/64 inch.
2. Units with Honed Faces: 1/32 inch.

E. Variation in Joint Width: Do not vary joint thickness more than 1/16 inch or one-fourth of nominal joint width, whichever is less.

3.8 CLEANING AND PROTECTING

A. Cleaning: On completion of placement and grouting, clean all ceramic tile surfaces so they are free of foreign matter.

1. Remove grout residue from tile as soon as possible.
2. Clean grout smears and haze from tile according to tile and grout manufacturer's written instructions but no sooner than 10 days after installation. Use only cleaners recommended by tile and grout manufacturers and only after determining that cleaners are safe to use by testing on samples of tile and other surfaces to be cleaned. Protect metal surfaces and plumbing fixtures from effects of cleaning. Flush surfaces with clean water before and after cleaning.
3. Remove temporary protective coating by method recommended by coating manufacturer and that is acceptable to tile and grout manufacturer. Trap and remove coating to prevent drain clogging.

B. Protect installed tile work with kraft paper or other heavy covering during construction period to prevent staining, damage, and wear. If recommended by tile manufacturer, apply coat of neutral protective cleaner to completed tile walls and floors.

C. Prohibit foot and wheel traffic from tiled floors for at least seven days after grouting is completed.

D. Before final inspection, remove protective coverings and rinse neutral protective cleaner from tile surfaces.

END OF SECTION

SECTION 095113 - ACOUSTICAL PANEL CEILINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes acoustical panels and exposed suspension systems for ceilings.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples: For each exposed product and for each color and texture specified, 6 inches in size.

C. Samples for Initial Selection: For components with factory-applied color finishes.

D. Samples for Verification: For each component indicated and for each exposed finish required, prepared on Samples of size indicated below.

1. Acoustical Panel: Set of 6-inch- square Samples of each type, color, pattern, and texture.
2. Exposed Suspension-System Members, Moldings, and Trim: Sample Set of each type, finish, and color.

1.4 INFORMATIONAL SUBMITTALS

A. Evaluation Reports: For each acoustical panel ceiling suspension system and anchor and fastener type, from ICC-ES.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For finishes to include in maintenance manuals.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Acoustical Ceiling Panels: Full-size panels equal to 5 percent of quantity installed.
2. Hold-Down Clips: Equal to 2 percent of quantity installed.
3. Impact Clips: Equal to 2 percent of quantity installed.

1.7 QUALITY ASSURANCE

A. 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 mockup of typical ceiling area as shown on Drawings.
2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver acoustical panels, suspension-system components, and accessories to Project site in original, unopened packages and store them in a fully enclosed, conditioned space where they will be protected against damage from moisture, humidity, temperature extremes, direct sunlight, surface contamination, and other causes.

B. Before installing acoustical panels, permit them to reach room temperature and a stabilized moisture content.

C. Handle acoustical panels carefully to avoid chipping edges or damaging units in any way.

1.9 FIELD CONDITIONS

A. Environmental Limitations: Do not install acoustical panel ceilings until spaces are enclosed and weatherproof, wet work in spaces is complete and dry, work above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

1. Pressurized Plenums: Operate ventilation system for not less than 48 hours before beginning acoustical panel ceiling installation.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: Comply with ASTM E 1264 for Class A materials.
2. Smoke-Developed Index: 50 or less.

2.2 ACOUSTICAL PANELS, GENERAL

A. Source Limitations: Obtain each type of acoustical ceiling panel and supporting suspension system from single source from single manufacturer.

B. Glass-Fiber-Based Panels: Made with binder containing no urea formaldehyde.

C. Acoustical Panel Standard: Provide manufacturer's standard panels of configuration indicated that comply with ASTM E 1264 classifications as designated by types, patterns, acoustical ratings, and light reflectances unless otherwise indicated.

1. Mounting Method for Measuring NRC: Type E-400; plenum mounting in which face of test specimen is 15-3/4 inches away from test surface according to ASTM E 795.

D. Acoustical Panel Colors and Patterns: Match appearance characteristics indicated for each product type.

1. Where appearance characteristics of acoustical panels are indicated by referencing pattern designations in ASTM E 1264 and not manufacturers' proprietary product designations, provide products selected by Architect from each manufacturer's full range that comply with requirements indicated for type, pattern, color, light reflectance, acoustical performance, edge detail, and size.

2.3 ACOUSTICAL PANELS

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

1. Armstrong World Industries, Inc.
2. CertainTeed Corp.
3. USG Interiors, Inc.

B. Acoustical Panels: ASTM E 1264, Types as indicated, from the following:

1. Type III, mineral base with painted finish.
2. Type IV, mineral base with membrane-faced overlay.
3. Type XII, glass-fiber base with membrane-faced overlay. Binder shall not contain urea formaldehyde.
4. Type XX, high-density, ceramic- and mineral-base panels with scrubbable finish, resistant to heat, moisture, and corrosive fumes.

2.4 METAL SUSPENSION SYSTEMS, GENERAL

A. Metal Suspension-System Standard: Provide manufacturer's standard direct-hung metal suspension systems of types, structural classifications, and finishes indicated that comply with applicable requirements in ASTM C 635/C 635M.

B. Attachment Devices: Size for five times the design load indicated in ASTM C 635/C 635M, Table 1, "Direct Hung," unless otherwise indicated. Comply with seismic design requirements.

1. Anchors in Concrete: Anchors of type and material indicated below, with holes or loops for attaching hangers of type indicated and with capability to sustain, without failure, a load equal to five times that imposed by ceiling construction, as determined by testing according to ASTM E 488 or ASTM E 1512 as applicable, conducted by a qualified testing and inspecting agency.
   a. Type: Postinstalled expansion anchors.
   b. Corrosion Protection: Carbon-steel components zinc plated to comply with ASTM B 633, Class Fe/Zn 5 (0.005 mm) for Class SC 1 service condition.
   c. Corrosion Protection: Stainless-steel components complying with ASTM F 593 and ASTM F 594, Group 1 Alloy 304 or 316 for bolts; Alloy 304 or 316 for anchor.
   d. Corrosion Protection: Components fabricated from nickel-copper-alloy rods complying with ASTM B 164 for UNS No. N04400 alloy.

2. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hangers of type indicated and with capability to sustain, without failure, a load equal to 10 times that imposed by ceiling construction, as determined by testing according to ASTM E 1190, conducted by a qualified testing and inspecting agency.

C. Wire Hangers, Braces, and Ties: Provide wires complying with the following requirements:

1. Zinc-Coated, Carbon-Steel Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper.
2. Stainless-Steel Wire: ASTM A 580/A 580M, Type 304, nonmagnetic.
3. Nickel-Copper-Alloy Wire: ASTM B 164, nickel-copper-alloy UNS No. N04400.
4. Size: Select wire diameter so its stress at three times hanger design load (ASTM C 635/C 635M, Table 1, "Direct Hung") will be less than yield stress of wire, but provide not less than 0.135-inch- diameter wire.

D. Hold-Down Clips: Where indicated, provide manufacturer's standard hold-down clips spaced 24 inches o.c. on all cross tees.

E. Impact Clips: Where indicated, provide manufacturer's standard impact-clip system designed to absorb impact forces against acoustical panels.

2.5 METAL SUSPENSION SYSTEM

A. Manufacturers:

1. Same as for acoustical units.

B. Ceiling Grids: Types as indicated, from the following:

1. Wide Face Suspension System: Formed galvanized steel, commercial quality cold rolled; intermediate-duty.
   a. Profile: Tee, 15/16 inch wide face.
   b. Construction: Double web.
   c. Finish: White painted, unless indicated otherwise.
   d. Basis-of-Design: Prelude ML manufactured by Armstrong.

2. Narrow Face Suspension System: Formed galvanized steel, commercial quality cold rolled; intermediate-duty.
   a. Profile: Tee, 9/16 inch wide face.
   b. Construction: Double web.
   c. Finish: White painted, unless indicated otherwise.
   d. Basis-of-Design: Superfine XL manufactured by Armstrong.

2.6 METAL EDGE MOLDINGS AND TRIM

A. Manufacturers: Subject to compliance with requirements, provide products by the suspension system manufacturer or one of the following:

1. Fry Reglet Corporation.
2. Gordon, Inc.
3. Rockfon.

B. Roll-Formed, Sheet-Metal Edge Moldings and Trim: Type and profile indicated or, if not indicated, suspension system manufacturer's standard moldings for edges and penetrations that comply with seismic design requirements; formed from sheet metal of same material, finish, and color as that used for exposed flanges of suspension-system runners.

1. Provide manufacturer's standard edge moldings that fit acoustical panel edge details and suspension systems indicated and that match width and configuration of exposed runners unless otherwise indicated.
2. For lay-in panels with reveal edge details, provide stepped edge molding that forms reveal of same depth and width as that formed between edge of panel and flange at exposed suspension member.

3. For circular penetrations of ceiling, provide edge moldings fabricated to diameter required to fit penetration exactly.

C. Extruded-Aluminum Edge Moldings and Trim: Where indicated, provide manufacturer's extruded-aluminum edge moldings and trim of profile indicated or referenced by manufacturer's designations, including splice plates, corner pieces, and attachment and other clips.

1. Basis-of-Design Product: Axiom Perimeter Trim, Shade Pockets, and Light Coves as manufactured by Armstrong.
2. Baked-Enamel or Powder-Coat Finish: Minimum dry film thickness of 1.5 mils. Comply with ASTM C 635/C 635M and coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.
   a. Color: White.

2.7 ACOUSTICAL SEALANT

A. Acoustical Sealant: As specified in Section 079200 “Joint Sealants”.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, including structural framing to which acoustical panel ceilings attach or abut, with Installer present, for compliance with requirements specified in this and other Sections that affect ceiling installation and anchorage and with requirements for installation tolerances and other conditions affecting performance of acoustical panel ceilings.

B. Examine acoustical panels before installation. Reject acoustical panels that are wet, moisture damaged, or mold damaged.

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

3.2 PREPARATION

A. Measure each ceiling area and establish layout of acoustical panels to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width panels at borders, and comply with layout shown on reflected ceiling plans.

3.3 INSTALLATION

A. General: Install acoustical panel ceilings to comply with ASTM C 636/C 636M, according to manufacturer's written instructions and CISCA's "Ceiling Systems Handbook."

B. Suspend ceiling hangers from building's structural members and as follows:

1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structure or of ceiling suspension system.
2. Splay hangers only where required and to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.

3. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers at spacings required to support standard suspension-system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices.
4. Secure wire hangers to ceiling-suspension members and to supports above with a minimum of three tight turns. Connect hangers directly either to structures or to inserts, eye screws, or other devices that are secure and appropriate for substrate and that will not deteriorate or otherwise fail due to age, corrosion, or elevated temperatures.
5. Secure flat, angle, channel, and rod hangers to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices that are secure and appropriate for both the structure to which hangers are attached and the type of hanger involved. Install hangers in a manner that will not cause them to deteriorate or fail due to age, corrosion, or elevated temperatures.
6. Do not support ceilings directly from permanent metal forms or floor deck. Fasten hangers to cast-in-place hanger inserts, postinstalled mechanical or adhesive anchors, or power-actuated fasteners that extend through forms into concrete.
7. When steel framing does not permit installation of hanger wires at spacing required, install carrying channels or other supplemental support for attachment of hanger wires.
8. Do not attach hangers to steel deck tabs.
9. Do not attach hangers to steel roof deck. Attach hangers to structural members.
10. Space hangers not more than 48 inches o.c. along each member supported directly from hangers unless otherwise indicated; provide hangers not more than 8 inches from ends of each member.
11. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards and publications.

C. Secure bracing wires to ceiling suspension members and to supports with a minimum of four tight turns. Suspend bracing from building's structural members as required for hangers, without attaching to permanent metal forms, steel deck, or steel deck tabs. Fasten bracing wires into concrete with cast-in-place or postinstalled anchors.

D. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical panels.

1. Apply acoustical sealant in a continuous ribbon concealed on back of vertical legs of moldings before they are installed.
2. Screw attach moldings to substrate at intervals not more than 16 inches o.c. and not more than 3 inches from ends, leveling with ceiling suspension system to a tolerance of 1/8 inch in 12 feet. Miter corners accurately and connect securely.
3. Do not use exposed fasteners, including pop rivets, on moldings and trim.

E. Install suspension-system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.

F. Install acoustical panels with undamaged edges and fit accurately into suspension-system runners and edge moldings. Scribe and cut panels at borders and penetrations to provide a neat, precise fit.

1. Arrange directionally patterned acoustical panels as follows:
   a. As indicated on reflected ceiling plans.
2. For reveal-edged panels on suspension-system runners, install panels with bottom of reveal in firm contact with top surface of runner flanges.
3. Paint cut edges of panel remaining exposed after installation; match color of exposed panel surfaces using coating recommended in writing for this purpose by acoustical panel manufacturer.

4. Install hold-down and impact clips in areas indicated, in areas required by authorities having jurisdiction; space as recommended by panel manufacturer's written instructions unless otherwise indicated.

3.4 ERECTION TOLERANCES

A. Suspended Ceilings: Install main and cross runners level to a tolerance of 1/8 inch in 12 feet, non-cumulative.

B. Moldings and Trim: Install moldings and trim to substrate and level with ceiling suspension system to a tolerance of 1/8 inch in 12 feet, non-cumulative.

3.5 CLEANING

A. Clean exposed surfaces of acoustical panel ceilings, including trim, edge moldings, and suspension-system members. Comply with manufacturer's written instructions for cleaning and touchup of minor finish damage.

B. Remove and replace ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION

SECTION 096513 - RESILIENT BASE AND ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Resilient base.
2. Resilient molding accessories.

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, not less than 12 inches long.

C. Samples for Initial Selection: For each type of product indicated.

D. Samples for Verification: For each type of product indicated and for each color, texture, and pattern required in manufacturer's standard-size Samples, but not less than 12 inches long.

E. Product Schedule: For resilient base and accessory products.

1.3 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Furnish not less than 10 linear feet for every 500 linear feet or fraction thereof, of each type, color, pattern, and size of resilient product installed.

1.4 QUALITY ASSURANCE

A. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Coordinate mockups in this Section with mockups specified in other Sections.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store resilient products and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F or more than 90 deg F.

1.6 FIELD CONDITIONS

A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F or more than 95 deg F, in spaces to receive resilient products during the following time periods:

1. 48 hours before installation.
2. During installation.
3. 48 hours after installation.

B. After installation and until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg F or more than 95 deg F.

C. Install resilient products after other finishing operations, including painting, have been completed.

PART 2 - PRODUCTS

2.1 THERMOSET-RUBBER BASE

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

1. Burke Flooring.
2. Flexco.
3. Johnsonite
4. Nora Systems, Inc.
5. Roppe Corporation

B. Product Standard: ASTM F 1861, Type TS (rubber, vulcanized thermoset), Group I (solid, homogeneous).

1. Style and Location:
   a. Style A, Straight: Provide in areas with carpet.
   b. Style B, Cove: Provide in areas with resilient (hard) flooring.

C. Thickness: 0.125 inch.

D. Height: 4 inches and 6 inches in accordance with Drawings.

E. Lengths: Rolls.

F. Outside Corners: Preformed.

G. Inside Corners: Preformed.

H. Colors: As selected by Architect from full range of industry colors.

2.2 RUBBER MOLDING ACCESSORY

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

1. Roppe Corporation, USA.
2. VPI, LLC, Floor Products Division.

B. Description: Rubber carpet edge for glue-down applications, nosing for carpet, nosing for resilient flooring, reducer strip for resilient flooring, joiner for resilient tile and carpet, and transition strips.

C. Colors and Patterns: As selected by Architect from full range of industry colors.

2.3 INSTALLATION MATERIALS

A. Trowelable Leveling and Patching Compounds: Latex-modified, portland cement based or blended hydraulic-cement-based formulation provided or approved by resilient-product manufacturer for applications indicated.

B. Adhesives: Water-resistant type recommended by resilient-product manufacturer for resilient products and substrate conditions indicated.

1. Adhesives shall have a VOC content of 50 g/L or less.

C. Metal Edge Strips: Extruded aluminum with mill finish of width shown, of height required to protect exposed edges of flooring, and in maximum available lengths to minimize running joints.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

1. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of resilient products.

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

1. Installation of resilient products indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.

B. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.

C. Do not install resilient products until they are the same temperature as the space where they are to be installed.

1. At least 48 hours in advance of installation, move resilient products and installation materials into spaces where they will be installed.

D. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient products.

3.3 RESILIENT BASE INSTALLATION

A. Comply with manufacturer's written instructions for installing resilient base.

B. Apply resilient base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.

C. Install resilient base in lengths as long as practical without gaps at seams and with tops of adjacent pieces aligned.

D. Tightly adhere resilient base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.

E. Do not stretch resilient base during installation.

F. On masonry surfaces or other similar irregular substrates, fill voids along top edge of resilient base with manufacturer's recommended adhesive filler material.

G. Preformed Corners: Install preformed corners before installing straight pieces.

3.4 RESILIENT ACCESSORY INSTALLATION

A. Comply with manufacturer's written instructions for installing resilient accessories.

B. Resilient Molding Accessories: Butt to adjacent materials and tightly adhere to substrates throughout length of each piece. Install reducer strips at edges of floor covering that would otherwise be exposed.

3.5 CLEANING AND PROTECTION

A. Comply with manufacturer's written instructions for cleaning and protecting resilient products.

B. Perform the following operations immediately after completing resilient-product installation:

1. Remove adhesive and other blemishes from exposed surfaces.
2. Sweep and vacuum horizontal surfaces thoroughly.
3. Damp-mop horizontal surfaces to remove marks and soil.

C. Protect resilient products from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.

D. Cover resilient products subject to wear and foot traffic until Substantial Completion.

END OF SECTION

SECTION 096519 - RESILIENT TILE FLOORING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Luxury vinyl floor tile.
2. Vinyl composition floor tile.

B. Related Requirements:

1. Section 090561 “Common Work Results for Flooring Preparation” for testing and preparation of concrete substrates.
2. Section 096513 “Resilient Base and Accessories” for transition strips and resilient flooring accessories.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For each type of floor tile. Include floor tile layouts, edges, columns, doorways, enclosing partitions, built-in furniture, cabinets, and cutouts.

1. Show details of special patterns.

C. Samples for Verification: Full-size units of each color and pattern of floor tile required.

D. Product Schedule: For floor tile. Use same designations indicated on Drawings.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For each type of floor tile to include in maintenance manuals.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Floor Tile: Furnish 4 percent of overall project quantity, but not less than one box for every 50 boxes or fraction thereof, of each type, color, and pattern of floor tile installed. Furnish one gallon container of each type adhesive used for flooring and base.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: A qualified installer who employs workers for this Project who are competent in techniques required by manufacturer for floor tile installation and seaming method indicated.

1. Engage an installer who employs workers for this Project who are trained or certified by floor tile manufacturer for installation techniques required.

B. 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 for floor tile including resilient base and accessories.
   a. Size: Minimum 100 sq. ft. for each type, color, and pattern in locations directed by Architect.
2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Store floor tile and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F or more than 90 deg F. Store floor tiles on flat surfaces.

1.8 FIELD CONDITIONS

A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F or more than 95 deg F, in spaces to receive floor tile during the following time periods:

1. 48 hours before installation.
2. During installation.
3. 48 hours after installation.

B. After installation and until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg F or more than 95 deg F.

C. Close spaces to traffic during floor tile installation.

D. Close spaces to traffic for 48 hours after floor tile installation.

E. Install floor tile after other finishing operations, including painting, have been completed.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Test-Response Characteristics: For resilient tile flooring, as determined by testing identical products according to ASTM E 648 or NFPA 253 by a qualified testing agency.

1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.

B. FloorScore Compliance: Resilient tile flooring shall comply with requirements of FloorScore certification.

2.2 GENERAL

A. Products: Subject to compliance with requirements, provide products as Scheduled on Drawings.

2.3 LUXURY VINYL FLOOR TILE

A. Tile Standard: ASTM F 1700.

1. Class: Class III, printed film vinyl tile.
2. Type: A, smooth surface.

B. Thickness: 0.125 inch.

C. Size: As indicated.

D. Colors and Patterns: As indicated on Drawings.

2.4 VINYL COMPOSITION FLOOR TILE

A. Tile Standard: ASTM F 1066, homogenous, with color extending throughout thickness.

B. Wearing Surface: Smooth.

C. Thickness: 0.125 inch.

D. Size: 12 by 12 inches.

E. Colors and Patterns: As indicated on Drawings.

2.5 ACCESSORY MATERIALS

A. Trowelable Leveling and Patching Compounds: As specified in Section 090561 "Common Work Results for Flooring Preparation."

B. Adhesives: Water-resistant type recommended by floor tile and adhesive manufacturers to suit floor tile and substrate conditions indicated.

C. Floor Polish: Provide protective, liquid floor-polish products recommended by floor tile manufacturer.

PART 3 - EXECUTION

3.1 PREPARATION

A. Prepare and test concrete substrates in accordance with Section 090561 “Common Work Results for Flooring Preparation” and the following:

1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.

2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by floor tile manufacturer. Do not use solvents.
3. Verify that substrate alkalinity falls within range on pH scale recommended by manufacturer in writing, but not less than 5 or more than 9 pH.
4. Verify that substrate moisture vapor emission and internal relative humidity values are withinn flooring manufacturer's written recommendations.
5. Fill cracks, holes, and depressions in substrates and remove bumps and ridges to produce a uniform and smooth substrate. Use trowelable leveling and patching compounds, according to manufacturer's written instructions, to fill cracks, holes, depressions, and protrusions in substrates. Fill or level cracks, holes and depressions 1/8 inch wide or wider and protrusions more than 1/32 inch unless more stringent requirements are required by manufacturer's written instructions. Use self-leveling compound for larger areas or areas with more extensive deformations in the concrete.
6. Do not install resilient tile flooring until it is the same temperature as the space where it is to be installed.
   a. At least 48 hours in advance of installation, move flooring and installation materials into spaces where they will be installed.
7. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient tile flooring.

3.2 INSTALLATION

A. Comply with manufacturer's written instructions for installing floor tile.

B. Lay out floor tiles from center marks established with principal walls, discounting minor offsets, so tiles at opposite edges of room are of equal width. Adjust as necessary to avoid using cut widths that equal less than one-half tile at perimeter.

   1. Lay tiles square with room axis.

C. Match floor tiles for color and pattern by selecting tiles from cartons in the same sequence as manufactured and packaged, if so numbered. Discard broken, cracked, chipped, or deformed tiles.

   1. Lay square tiles with grain direction alternating in adjacent tiles (basket-weave pattern), unless otherwise indicated.

D. Scribe, cut, and fit floor tiles to butt neatly and tightly to vertical surfaces and permanent fixtures including built-in furniture, cabinets, pipes, outlets, and door frames.

E. Extend floor tiles into toe spaces, door reveals, closets, and similar openings. Extend floor tiles to center of door openings.

F. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on floor tiles as marked on substrates. Use chalk or other nonpermanent marking device.

G. Install floor tiles on covers for telephone and electrical ducts, building expansion-joint covers, and similar items in finished floor areas. Maintain overall continuity of color and pattern between pieces of tile installed on covers and adjoining tiles. Tightly adhere tile edges to substrates that abut covers and to cover perimeters.

H. Adhere floor tiles to flooring substrates using a full spread of adhesive applied to substrate to produce a completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.

3.3 CLEANING AND PROTECTION

A. Comply with manufacturer's written instructions for cleaning and protecting floor tile.

B. Perform the following operations immediately after completing floor tile installation:

1. Remove adhesive and other blemishes from exposed surfaces.
2. Sweep and vacuum surfaces thoroughly.
3. Damp-mop surfaces to remove marks and soil.

C. Protect floor tile from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.

D. Floor Polish: Remove soil, adhesive, and blemishes from floor tile surfaces before applying liquid floor polish.

1. Apply two coat(s).

E. Cover floor tile until Substantial Completion.

END OF SECTION

SECTION 096536 - STATIC-CONTROL RESILIENT FLOORING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Static-dissipative vinyl composition floor tile.

B. Related Requirements:

1. Section 096513 "Resilient Base and Accessories" for resilient base, reducer strips, and other accessories installed with static-control resilient flooring.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review methods and procedures related to static-control resilient flooring including, but not limited to, the following:
   a. Examination and preparation of substrates to receive static-control resilient flooring.
   b. Installation.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For each type of static-control resilient flooring. Include floor-covering layouts, edges, columns, doorways, enclosing partitions, built-in furniture, cabinets, and cutouts.

1. Show details of special patterns.
2. Show locations of inscribed maintenance tiles.
3. Submit grounding diagram showing location of grounding strips and connections.

C. Samples for Initial Selection: For each type of static-control resilient flooring.

D. Samples for Verification: For each type of static-control resilient flooring, of size indicated below:

1. Floor Tile: Full-size units.

E. Product Schedule: For static-control resilient flooring. Use same designations indicated on Drawings.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for static-control resilient flooring.

C. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For each type of static-control resilient flooring to include in maintenance manuals.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Floor Tile: Furnish one box for every 50 boxes or fraction thereof, of each type, color, and pattern of floor tile installed.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: A qualified installer who employs workers for this Project who are competent in techniques required by manufacturer for static-control resilient flooring.

1. Engage an installer who employs workers for this Project who are trained or certified by manufacturer for installation techniques required.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Store static-control resilient flooring and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer but not less than 50 deg F or more than 90 deg F.

1. Floor Tile: Store on flat surfaces.

1.9 PROJECT CONDITIONS

A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F or more than 85 deg F, in spaces to receive static-control resilient flooring during the following time periods:

1. 48 hours before installation.
2. During installation.
3. 48 hours after installation.

B. Until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg F or more than 95 deg F.

C. Close spaces to traffic during static-control resilient flooring installation.

D. Close spaces to traffic for 48 hours after static-control resilient flooring installation.

E. Install static-control resilient flooring after other finishing operations, including painting, have been completed.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Static-Dissipative Properties: Provide static-control resilient flooring with static-control properties indicated as determined by testing identical products per test method indicated by an independent testing and inspecting agency.

1. Electrical Resistance: Test per ASTM F 150 with 100-V applied voltage.
   a. Average greater than 1 megohm and less than or equal to 1000 megohms when test specimens are tested surface to ground.
   b. Average greater than 1 megohm and less than or equal to 1000 megohms when installed floor coverings are tested surface to ground.
2. Static Generation: Less than 300 V when tested per AATCC-134 at 20 percent relative humidity with conductive footwear.
3. Static Decay: 5000 to zero V in less than 0.50 seconds when tested per FED-STD-101C/4046.1.

B. Fire-Test-Response Characteristics: As determined by testing identical products according to ASTM E648 or NFPA 253 by a qualified testing agency.

1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.

2.2 STATIC-DISSIPATIVE RESILIENT FLOOR COVERINGS

A. Static-Dissipative, Vinyl Composition Floor Tile: ASTM F1066 (vinyl composition floor tile, nonasbestos formulated), Class 2 (through-pattern tile).

1. Basis-of-Design: Subject to compliance with requirements, provide Excelon SDT as manufactured by Armstrong Flooring; www.armstrongflooring.com.
2. Thickness: Not less than 0.125 inch.
3. Size: 12 by 12 inches.
4. Colors and Patterns: As indicated.

2.3 INSTALLATION MATERIALS

A. Trowelable Leveling and Patching Compounds: Latex-modified portland cement or blended hydraulic-cement-based formulation provided or approved by manufacturer for applications indicated.

B. Static-Control Adhesive: Provided or approved by manufacturer; type that maintains electrical continuity of floor-covering system to ground connection.

C. Grounding Strips: Provided or approved by manufacturer; type and size that maintains electrical continuity of floor-covering system to ground connection.

D. Floor Polish: Provide protective, static-control liquid floor polish products as recommended by floor-covering manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

B. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion or static-control characteristics of floor coverings.

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

3.2 PREPARATION

A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of static-control resilient flooring and electrical continuity of floor-covering systems.

B. Concrete Substrates: Prepare according to ASTM F710.

1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
2. Remove substrate coatings and other substances that are incompatible with floor-covering adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.
3. Alkalinity and Adhesion Testing: Perform tests recommended by manufacturer. Proceed with installation only after substrates pass testing.
4. Moisture Testing: Perform tests recommended by manufacturer and as follows. Proceed with installation only after substrates pass testing.
   a. Perform anhydrous calcium chloride test according to ASTM F1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft in 24 hours.
   b. Perform relative-humidity test using in situ probes according to ASTM F2170. Proceed with installation only after substrates have maximum 75 percent relative-humidity level measurement.

C. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound and remove bumps and ridges to produce a uniform and smooth substrate.

D. Do not install static-control resilient flooring until it is same temperature as space where it is to be installed.

1. Move static-control resilient flooring and installation materials into spaces where they will be installed at least 48 hours in advance of installation.

E. Sweep and vacuum substrates to be covered by static-control resilient flooring immediately before installation.

3.3 INSTALLATION, GENERAL

A. Install static-control resilient flooring according to manufacturer's written instructions.

B. Embed grounding strips in static-control adhesive. Extend grounding strips beyond perimeter of static-control resilient floor-covering surfaces to ground connections.

C. Scribe, cut, and fit static-control resilient flooring to butt neatly and tightly to vertical surfaces and permanent fixtures including built-in furniture, cabinets, pipes, outlets, and door frames.

D. Extend static-control resilient flooring into toe spaces, door reveals, closets, and similar openings. Extend static-control resilient flooring to center of door openings.

E. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on static-control resilient flooring as marked on substrates. Use chalk or other nonpermanent, nonstaining marking device.

F. Install static-control resilient flooring on covers for telephone and electrical ducts, and similar items in installation areas. Maintain overall continuity of color and pattern with pieces of static-control resilient flooring installed on covers. Tightly adhere static-control resilient flooring edges to substrates that abut covers and to cover perimeters.

G. Adhere static-control resilient flooring to substrates using a full spread of static-control adhesive applied to substrate to produce a completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.

3.4 FLOOR-TILE INSTALLATION

A. Comply with manufacturer's written instructions for installing floor tile.

B. Lay out floor tiles from center marks established with principal walls, discounting minor offsets, so floor tiles at opposite edges of room are of equal width. Adjust as necessary to avoid using cut widths that equal less than one-half floor tile at perimeter.

1. Lay floor tiles square with room axis in pattern indicated.

C. Match floor tiles for color and pattern by selecting floor tiles from cartons in same sequence as manufactured and packaged if so numbered. Discard broken, cracked, chipped, or deformed floor tiles.

1. Lay static-dissipative, vinyl composition floor tiles with grain direction alternating in adjacent floor tiles (basket-weave pattern).

3.5 FIELD QUALITY CONTROL

A. Testing: Engage a qualified testing agency to test electrical resistance of static-control resilient flooring for compliance with requirements.

1. Arrange for testing after static-control adhesives have fully cured and static-control resilient flooring has stabilized to ambient conditions and after ground connections are completed.
2. Arrange for testing of static-control resilient flooring before and after performing floor polish procedures.

B. Static-control resilient flooring will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

3.6 CLEANING AND PROTECTION

A. Comply with manufacturer's written instructions for cleaning and protection of static-control resilient flooring.

B. Perform the following operations immediately after completing static-control resilient flooring:

1. Remove static-control adhesive and other blemishes from exposed surfaces.
2. Sweep and vacuum surfaces thoroughly.
3. Damp-mop surfaces to remove marks and soil.

C. Protect static-control resilient flooring from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.

1. Do not wax static-control resilient flooring.
2. If recommended in writing by manufacturer, apply protective static-control floor polish formulated to maintain or enhance floor covering's electrical properties; ensure static-control resilient flooring surfaces are free from soil, static-control adhesive, and surface blemishes.
   a. Verify that both floor polish and its application method are approved by manufacturer and that floor polish will not leave an insulating film that reduces static-control resilient flooring's effectiveness for static control.

D. Cover static-control resilient flooring until Substantial Completion.

END OF SECTION 096536

SECTION 096813 - TILE CARPETING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Carpet tile, fully adhered.

B. Related Requirements:

1. Section 090561 “Common Work Results for Flooring Preparation” for testing and preparation of concrete substrates.

1.2 SUBMITTALS

A. Product Data: Provide data on specified products, describing physical and performance characteristics; sizes, patterns, colors available, and method of installation.

B. Samples: Submit two carpet tiles illustrating color and pattern design for each carpet color selected.

C. Manufacturer's Installation Instructions: Indicate special procedures and perimeter conditions requiring special attention.

D. Maintenance Data: Include maintenance procedures, recommended maintenance materials, and suggested schedule for cleaning.

E. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.

1. Extra Carpet Tiles: Full size tiles equal to 5 percent of each color and pattern installed.

1.3 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing specified carpet tile with minimum five years documented experience.

B. Installer Qualifications: Company specializing in installing carpet with minimum three years experience.

1.4 FIELD CONDITIONS

A. Store materials in area of installation for minimum period of 24 hours prior to installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Carpet Tile: Refer to Finish Schedule for colors and patterns.

2.2 ACCESSORIES

A. Edge Strips: Resilient type, in accordance with Section 096513 “Resilient Base and Accessories.”.

B. Adhesives: Acceptable to carpet tile manufacturer, compatible with materials being adhered; maximum VOC of 50 g/L; CRI Green Label certified ; in lieu of labeled product, independent test report showing compliance is acceptable.

C. Trowelable Leveling and Patching Compounds: As specified in Section 090561 “Common Work Results for Flooring Preparation.”

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

1. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of flooring.

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

3.2 PREPARATION

A. Prepare and test concrete substrates in accordance with Section 090561 “Common Work Results for Flooring Preparation.”

B. Do not install flooring until it is the same temperature as the space where it is to be installed.

1. At least 48 hours in advance of installation, move flooring and installation materials into spaces where they will be installed.

C. Immediately before installation, sweep and vacuum clean substrates to be covered by flooring.

3.3 INSTALLATION

A. Starting installation constitutes acceptance of sub-floor conditions.

B. Install carpet tile in accordance with manufacturer's instructions and CRI Carpet Installation Standard.

C. Install carpet tile in accordance with manufacturer's instructions and CRI 104.

D. Blend carpet from different cartons to ensure minimal variation in color match.

E. Cut carpet tile clean. Fit carpet tight to intersection with vertical surfaces without gaps. Trim pet tile neatly at walls and around interruptions.

F. Lay carpet tile in square pattern, with pile direction parallel to next unit, set parallel to building lines, unless otherwise indicated.

G. Locate change of color or pattern between rooms under door centerline.

H. Fully adhere carpet tile to substrate.

I. Complete installation of edge strips, concealing exposed edges.

3.4 CLEANING

A. Remove excess adhesive without damage, from floor, base, and wall surfaces.

B. Clean and vacuum carpet surfaces.

END OF SECTION

SECTION 099000 - PAINTING AND COATING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Surface preparation.
2. Field application of paints, stains, varnishes, and other coatings.
3. Surfaces to be finished are indicated in this section and on the Drawings.

1.2 REFERENCE STANDARDS

A. 40 CFR 59, Subpart D - National Volatile Organic Compound Emission Standards for Architectural Coatings; U.S. Environmental Protection Agency.

B. MPI (APL) - Master Painters Institute Approved Products List; Master Painters and Decorators Association.

C. MPI (APSM) - Master Painters Institute Architectural Painting Specification Manual; Master Painters and Decorators Association.

D. PDCA P5 - Painters and Decorators Contractors of America, Benchmark Sample Procedures for Paint and Other Decorative Coating Systems, 2004.

1.3 DEFINITIONS

A. General: Standard coating terms defined in ASTM D 16 apply to this Section.

1. Flat refers to a lusterless or matte finish with a gloss range below 15 when measured at an 85-degree meter.
2. Eggshell refers to low-sheen finish with a gloss range between 20 and 35 when measured at a 60-degree meter.
3. Semigloss refers to medium-sheen finish with a gloss range between 35 and 70 when measured at a 60-degree meter.

1.4 SUBMITTALS

A. Product Data: For each paint system indicated. Include block fillers and primers.

B. Material List: Manufacturer's name, product name and/or catalog number, and general product category (e.g. "alkyd enamel").

1. MPI product number (e.g. MPI #47).
2. Cross-reference to specified paint system(s) product is to be used in; include description of each system (copy of relevant MPI Manual page is acceptable).

C. Manufacturer's Information: Manufacturer's technical information, including label analysis and instructions for handling, storing, and applying each coating material.

D. If proposal of substitutions is allowed under submittal procedures, explanation of all substitutions proposed. Where equal product by listed manufacturer other than basis of design, provide line-by-line comparison of substituted product with specified product and cross-reference to MPI specification..

E. Certification by manufacturer that products comply with Contract Documents and are compatible with applicable substrates and with each other.

F. Certification: By manufacturer that all paints and coatings comply with VOC limits specified.

G. Certification: By manufacturer that all paints and coatings do not contain any of the prohibited chemicals specified; GreenSeal GS-11 certification is not required but if provided shall constitute acceptable certification.

H. Shop Drawings: Submit drawing or schedule showing all locations that will receive epoxy paint.

I. Samples: Submit three paper "drop" samples, 8-1/2 by 11 inches in size, illustrating range of colors available for each finishing product specified, with texture to simulate actual conditions.

1. Provide stepped Samples, defining each separate coat, including block fillers and primers. Use representative colors when preparing Samples for review. Resubmit until required sheen, color, and texture are achieved.
2. Provide a list of materials and applications for each coat of each Sample. Label each Sample for location and application.
3. Where sheen is specified, submit samples in only that sheen.
4. Where sheen is not specified, submit each color in each sheen available.
5. Allow 30 days for approval process, after receipt of complete samples by Architect.
6. Paint color submittals will not be considered until color submittals for major materials not to be painted, such as masonry, factory finished metals, wood cabinets, and wood doors, have been approved.

J. Maintenance Data: Submit data on cleaning, touch-up, and repair of painted and coated surfaces.

1.5 QUALITY ASSURANCE

A. Applicator Qualifications: Company specializing in performing the work of this section with minimum five years' experience whose work has resulted in applications with a record of successful in-service performance.

B. Maintain one copy of relevant portions of MPI Architectural Painting Specification Manual on project site at all times.

C. Material Safety Data Sheets: At project site maintain file of MSDS sheets for each product used; become familiar with and follow manufacturers' stated application and safety requirements.

D. Source Limitations: Obtain block fillers and primers for each coating system from the same manufacturer as the finish coats.

E. Benchmark Samples (Mockups): Provide a full-coat benchmark finish sample for each type of coating and substrate required. Comply with procedures specified in PDCA P5. Duplicate finish of approved sample Submittals.

1. See Section 014000 "Quality Requirements", for general requirements for mock-up.

2. Architect will select one room or surface to represent surfaces and conditions for application of each type of coating and substrate.
   a. Wall Surfaces: Provide samples on at least 100 sq. ft.
   b. Small Areas and Items: Architect will designate items or areas required.
   c. Provide door and frame assembly illustrating coating color, texture, and finish.
   d. Apply benchmark samples, according to requirements for the completed Work, after permanent lighting and other environmental services have been activated. Provide required sheen, color, and texture on each surface.
      1) After finishes are accepted, Architect will use the room or surface to evaluate coating systems of a similar nature.
   e. Final approval of colors will be from benchmark samples.
   f. Mock-up may remain as part of the Work, except as directed by Architect.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to Project site in manufacturer's original, unopened packages and containers bearing manufacturer's name and label and the following information:

1. Product description (type of paint);
2. MPI designation;
3. Lot number and date of manufacture;
4. Color name and number;
5. Coverage;
6. Surface preparation;
7. Drying time;
8. Cleanup requirements;
9. Instructions for mixing and reducing;
10. Application instructions;
11. VOC content.
12. 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. Maintain storage containers in a clean condition, free of foreign materials and residue.

1.7 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. Minimum Application Temperatures for Waterborne Paints: 50 deg F for interiors; unless required otherwise by manufacturer's instructions. Apply waterborne paints only when temperatures of surfaces to be painted and surrounding air are between 50 and 90 deg F.

1.8 EXTRA MATERIALS

A. See Section 016000 “Product Requirements”, for additional provisions.

B. Supply 1 gallon of each color; store where directed.

C. Label each container with color in addition to the manufacturer's label.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Provide all paint and coating products used in any individual system from the same manufacturer.

B. In the event that a single manufacturer cannot provide all specified products, minor exceptions will be permitted provided approval by Architect is obtained using the specified procedures for substitutions.

1. Substitution of other products by the same manufacturer is preferred over substitution of products by a different manufacturer.
2. Substitution of a different system using MPI-approved products by the same manufacturer will be considered.

C. Basis of Design: The Sherwin-Williams Company (S-W); www.sherwin-williams.com.

1. Subject to compliance with requirements, comparable products from the following manufacturers may be acceptable:
   a. Benjamin Moore & Co: www.benjaminmoore.com.
   b. PPG Paints: www.ppgpaints.com.

2.2 MATERIALS - GENERAL

A. Volatile Organic Compound (VOC) Content:

1. Provide coatings that comply with the most stringent requirements specified in the following:
   a. 40 CFR 59, Subpart D--National Volatile Organic Compound Emission Standards for Architectural Coatings.
   b. Architectural coatings VOC limits of State in which the project is located.
   c. GreenSeal Standard GS-11

2. Determination of VOC Content: Testing and calculation in accordance with 40 CFR 59, Subpart D (EPA Method 24), exclusive of colorants added to a tint base and water added at project site; or other method acceptable to authorities having jurisdiction.

B. Chemical Content: The following compounds are prohibited:

1. Aromatic Compounds: In excess of 1.0 percent by weight of total aromatic compounds (hydrocarbon compounds containing one or more benzene rings).
2. Acrolein, acrylonitrile, antimony, benzene, butyl benzyl phthalate, cadmium, di (2-ethylhexyl) phthalate, di-n-butyl phthalate, di-n-octyl phthalate, 1,2-dichlorobenzene, diethyl phthalate., dimethyl phthalate, ethylbenzene, formaldehyde, hexavalent chromium, isophorone, lead, mercury, methyl ethyl ketone, methyl isobutyl ketone, methylene chloride, naphthalene, toluene (methylbenzene), 1,1,1-trichloroethane, vinyl chloride.

C. Material Compatibility: Provide block fillers, primers, and finish-coat materials that are compatible with one another and with the substrates indicated under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.

D. Material Quality: Provide manufacturer's best-quality paint material of the various coating types specified that are factory formulated and recommended by manufacturer for application indicated. Paint-material containers not displaying manufacturer's product identification will not be acceptable.

1. Proprietary Names: Use of manufacturer's proprietary product names to designate colors or materials is not intended to imply that products named are required to be used to the exclusion of equivalent products of other manufacturers. Furnish manufacturer's material data and certificates of performance for proposed substitutions.

E. Paints and Coatings: Provide products listed in Master Painters Institute Approved Product List, current edition available at www.paintinfo.com, for specified MPI Categories, except as otherwise indicated.

1. Provide ready mixed paints and coatings, except field-catalyzed coatings.
2. Where actual products are indicated, specified product takes precedence over MPI designation. Provide the specified product or equal product by other listed manufacturer in lieu of MPI designation. In no way will products of lessor quality, as specified by either MPI designation or actual product, be permitted.

F. Accessory Materials: Linseed oil, shellac, turpentine, paint thinners and other materials not specifically indicated but required to achieve the finishes specified; commercial quality.

1. Patching Material: Latex filler.
2. Fastener Head Cover Material: Latex filler.

2.3 PAINT SYSTEMS

A. Provide products as scheduled. Where specific products are not specified use any product by same manufacturer complying with the requirements of the specified MPI designation. MPI systems are listed to designate a level of quality for comparison between manufacturers only. Provide Premium Grade systems (2 top coats) as defined in MPI Architectural Painting Specification Manual, except as otherwise indicated.

B. Where a specified paint system does not have a Premium Grade, provide Custom Grade system (with 2 top coats).

C. Where sheen is not specified or more than one sheen is specified, sheen will be selected later by Architect from the manufacturer's full line.

D. Provide colors as directed by Architect.

1. Allow for minimum of three colors for each system for each room or space, unless otherwise indicated, without additional cost to Owner.
2. Extend colors to surface edges; colors may change at any edge as directed by Architect.

PART 3 - EXECUTION

3.1 SCOPE – SURFACES TO BE FINISHED

A. Paint all exposed surfaces except where indicated not to be painted or to remain natural; the term "exposed" includes areas visible through permanent and built-in fixtures when they are in place.

B. Paint the surfaces described in PART 2, indicated on the Drawings, and as follows:

1. If a surface, material, or item is not specifically mentioned, paint in the same manner as similar surfaces, materials, or items, regardless of whether colors are indicated or not.
2. Paint surfaces behind movable equipment and furnishings the same as similar exposed surfaces.
3. Paint surfaces to be concealed behind permanently installed fixtures, equipment, and furnishings, using primer only, prior to installation of the permanent item.
4. Paint back sides of access panels and removable and hinged covers to match exposed surfaces.
5. Finish top, bottom, and side edges of exterior doors the same as exposed faces.
6. Paint all insulated and exposed pipes, conduit, boxes, insulated and exposed ducts, hangers, brackets, collars and supports, mechanical equipment, and electrical equipment occurring in finished areas to match background surfaces, unless otherwise indicated.
7. Paint equipment, piping, conduit, and exposed duct work in utility areas in colors according to the color coding scheme indicated.
8. Paint all mechanical and electrical equipment exposed to weather, or exposed to view on the roof and outdoors, except for factory-finished equipment where finish is intended for outdoor exposure.
9. Paint shop-primed mechanical and electrical items occurring in finished areas.
10. Remove unfinished louvers, grilles, covers, and access panels on mechanical and electrical components and paint separately.
11. Paint interior surfaces of air ducts and convector and baseboard heating cabinets with flat, non-specular black paint where visible through registers, grilles, or louvers.
12. Paint dampers exposed behind louvers, grilles, and convector and baseboard cabinets to match face panels.
13. Paint both sides and edges of plywood backboards for electrical and telephone equipment before installing equipment.
14. Do Not Paint or Finish the Following Items:
    a. Items fully factory-finished unless specifically noted; factory-primed items are not considered factory-finished.
    b. Items indicated to receive other finish.
    c. Items indicated to remain naturally finished.
    d. Fire rating labels, equipment serial number and capacity labels, and operating parts of equipment.
    e. Anodized aluminum.
    f. Polished and brushed stainless steel items.
    g. Brick, precast concrete, integrally colored plaster.
    h. Concrete masonry in utility, mechanical, and electrical spaces.
    i. Polished and brushed stainless steel, anodized aluminum, bronze, terne, and lead.
    j. Acoustical materials.
    k. Concealed piping, ductwork, and conduit.

3.2 EXAMINATION

A. Verify that surfaces are ready to receive Work as instructed by the product manufacturer.

B. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially affect proper application.

C. Test shop-applied primer for compatibility with subsequent cover materials; report incompatible primer conditions and submit recommended changes for Architect's approval.

D. Measure moisture content of surfaces using an electronic moisture meter. Do not apply finishes unless moisture content of surfaces are below the following maximums:

1. Plaster and Gypsum Board: 12 percent.
2. Masonry, Concrete, and Concrete Unit Masonry: 12 percent.
3. Interior Wood: 15 percent, measured in accordance with ASTM D 4442.
4. Exterior Wood: 15 percent, measured in accordance with ASTM D 4442.
5. Concrete Floors: 8 percent.
6. Measure the pH factor of concrete, masonry, and mortar before starting any finishing process, using the method specified in MPI Architectural Painting Manual.
   a. Report results in writing to Architect before starting work.
   b. If results of test indicates need for remedial action, provide written description of remedial action. If a different primer or paint systems is required, state the total cost of the change. Do not proceed with remedial action or change without receiving written authorization from Architect.

3.3 PREPARATION

A. Prepare surfaces as specified in MPI Architectural Painting Specification Manual and as follows for the applicable surface and coating; if multiple preparation treatments are specified, use as many as necessary for best results; where the Manual references external standards for preparation (e.g. SSPC standards), prepare as specified in those standards; comply with coating manufacturer's specific preparation methods or treatments, if any.

B. Coordinate painting work with cleaning and preparation work so that dust and other contaminants do not fall on newly painted, wet surfaces.

C. Surface Appurtenances: Prior to preparing surfaces or finishing, remove electrical plates, hardware, light fixtures, light fixture trim, escutcheons, machined surfaces, fittings, and similar items already installed that are not to be painted.

1. If removal is impractical or impossible because of the size or weight of the item, provide surface-applied protection before preparation and finishing.
2. After completing painting in each space or area, reinstall items removed using workers skilled in the trades involved.
3. Surfaces: Correct defects and clean surfaces which affect work of this section. Remove or repair existing coatings that exhibit surface defects.
4. Marks: Seal with shellac those which may bleed through surface finishes.
5. Impervious Surfaces: Remove mildew by scrubbing with solution of tetra-sodium phosphate and bleach. Rinse with clean water and allow surface to dry.
6. Concrete, Cement Plaster and Unit Masonry Surfaces to be Painted: Remove dirt, loose mortar, scale, salt or alkali powder, and other foreign matter. Remove oil and grease with a solution of tri-sodium phosphate; rinse well and allow to dry. Remove stains caused by weathering of corroding metals with a solution of sodium metasilicate after thoroughly wetting with water. Allow to dry.
   a. Prepare concrete, concrete masonry block, cement plaster, and mineral-fiber-reinforced cement panel surfaces to be painted. Remove efflorescence, chalk, dust, dirt, grease, oils, and release agents. Roughen as required to remove glaze. If hardeners or sealers have been used to improve curing, use mechanical methods of surface preparation.
   b. Determine alkalinity and moisture content of surfaces by performing appropriate tests as specified in MPI Manual. If surfaces are sufficiently alkaline to cause the finish paint to blister and burn, correct this condition before application. Do not paint surfaces where moisture is present.

7. Gypsum Board Surfaces to be Painted: Fill minor defects with filler compound. Spot prime defects after repair.
8. Aluminum Surfaces to be Painted: Remove surface contamination by steam or high pressure water. Remove oxidation with acid etch and solvent washing. Apply etching primer immediately following cleaning.
9. Galvanized Surfaces to be Painted: Remove surface contamination and oils and wash with solvent. Apply coat of etching primer.
10. Uncoated Steel and Iron Surfaces to be Painted: Remove grease, mill scale, weld splatter, dirt, and rust. Where heavy coatings of scale are evident, remove by hand wire brushing or sandblasting; clean by washing with solvent. Apply a treatment of phosphoric acid solution, ensuring weld joints, bolts, and nuts are similarly cleaned. Prime paint entire surface; spot prime after repairs.
    a. Use solvent or mechanical cleaning methods that comply with the Steel Structures Painting Council's (SSPC) recommendations. Touch up bare areas and shop-applied prime coats that have been damaged. Wire-brush, clean with solvents recommended by paint manufacturer, and touch up with the same primer as the shop coat.
11. Shop-Primed Steel Surfaces to be Finish Painted: Sand and scrape to remove loose primer and rust. Feather edges to make touch-up patches inconspicuous. Clean surfaces with solvent. Prime bare steel surfaces. Re-prime entire shop-primed item.
12. Interior Wood Items to Receive Opaque Finish: Sand to remove any loose or deteriorated surface wood and to obtain a proper surface profile. Patch all holes and imperfections with a wood filler or putty and sand smooth.
13. Metal Doors to be Painted: Prime metal door top and bottom edge surfaces.

3.4 APPLICATION

A. Apply products in accordance with manufacturer's instructions and as specified or recommended by MPI Manual, using the preparation, products, sheens, textures, and colors as indicated.

1. Provide completed work matching approved samples for color, texture, and coverage.
2. Remove, refinish, or repaint work not complying with requirements.
3. Do not apply finishes over dirt, rust, scale, grease, moisture, scuffed surfaces, or other conditions detrimental to formation of a durable coating film; do not apply finishes to surfaces that are not dry.
4. Use applicators and methods best suited for substrate and type of material being applied and according to manufacturer's instructions.
    a. Brush Application: Use brushes best suited for the type of material applied; use brush of appropriate size for the surface or item being painted; produce results free of visible brush marks.
    b. Roller Application: Use rollers of carpet, velvet back, or high-pile sheep's wool as recommended by manufacturer for material and texture required.
    c. Spray Application: Use airless spray equipment with orifice size as recommended by manufacturer for material and texture required.
    d. Where application method is listed in the MPI Manual for the paint system that application method is required; otherwise any application method recommended by manufacturer for material used and objects to be painted is acceptable.
5. Minimum Coating Thickness: Apply paint materials no thinner than manufacturer's recommended spreading rate; provide total dry film thickness of entire system as instructed by manufacturer or specified herein, whichever is the more stringent.
    a. Number of coats and film thickness required are the same regardless of application method.

b. If undercoats, stains, or other conditions show through final coat of paint, apply additional coats until paint film is of uniform finish, color, and appearance.
c. Give special attention to ensure edges, corners, crevices, welds, and exposed fasteners receive dry film thickness equivalent to that of flat surfaces.

6. Apply finish to completely cover surfaces with uniform appearance without brush marks, runs, sags, laps, ropiness, holidays, spotting, cloudiness, or other surface imperfections.
   a. Apply each coat of paint slightly darker than preceding coat.
   b. Before applying finish coats, apply a prime coat of material recommended by manufacturer, unless the surface has been prime coated by others; where evidence of suction spots or unsealed areas in first coat appear, recoat primed and sealed surfaces to ensure finish coat with no burn through or other defects due to insufficient sealing.
   c. Apply first coat to surface that has been cleaned, pretreated, or otherwise prepared as soon as practical after preparation and before subsequent surface deterioration.
   d. Do not apply succeeding coats until the previous coat has cured as recommended by manufacturer.
   e. Do not recoat until paint has dried to where it feels firm, does not deform or feel sticky under moderate thumb pressure, and application of another coat will not cause the undercoat to lift or lose adhesion.
   f. If manufacturer's instructions recommend sanding to produce a smooth, even surface, sand between coats.
   g. Before applying next coat vacuum clean surfaces of loose particles. Use tack cloth to remove dust and particles just prior to applying next coat.
   h. Pigmented (Opaque) Finishes: Provide smooth, opaque surface of uniform finish, color, appearance, and coverage.
   i. Stippled Finish: Roll and redistribute paint to even, fine texture; leave no evidence of rolling, such as laps, irregularity in texture, skid marks, or other surface imperfections; back roll final coat to achieve a uniform surface.

7. Where adjacent sealant is to be painted, do not apply finish coats until sealant is applied.

3.5 FIELD QUALITY CONTROL

A. See Section 014000 - Quality Requirements, for general requirements for field inspection.

B. Owner reserves the right to invoke the following test procedure at any time and as often as Owner deems necessary during the period when paint is being applied:

1. Owner may engage a qualified independent testing agency to sample paint material being used. Samples of material delivered to Project will be taken, identified, sealed, and certified in the presence of Construction Manager.
2. Owner may direct Construction Manager to stop painting if test results show material being used does not comply with specified requirements. Construction Manager shall remove noncomplying paint from Project site, pay for testing, and repaint surfaces previously coated with the noncomplying paint. If necessary, Contractor may be required to remove noncomplying paint from previously painted surfaces if, on repainting with specified paint, the two coatings are incompatible.

3.6 CLEANING AND PROTECTION

A. Collect waste material which may constitute a fire hazard, place in closed metal containers, and remove daily from site.

B. At the end of each workday, remove empty cans, rags, rubbish, and other discarded paint materials from site.

C. Protect other work, whether being painted or not, against damage by painting. Correct damage by cleaning, repairing or replacing, and repainting as approved by Architect.

D. Provide "Wet Paint" signs to protect newly painted finishes. Remove temporary protective wrappings provided by others to protect their work after completing painting operations.

E. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces. Comply with procedures specified in MPI Manual.

3.7 EXTERIOR PAINTING SCHEDULE

A. CMU Substrates:

1. Latex System:
   a. Prime Coat: Block filler, latex, interior/exterior, MPI #4.
      1) S-W Loxon Block Surfacer.
   b. Topcoats (2 required): Latex, exterior satin (Gloss Level 4), MPI #15.
      1) S-W A-100 Exterior Latex Satin.

B. Galvanized-Metal Substrates:

1. Water-Based Light Industrial Coating System:
   a. Prime Coat: Primer, galvanized, water based, MPI #134.
      1) S-W Pro Industrial Pro-Cryl Universal Primer.
   b. Topcoats (2 required): Light industrial coating, exterior, water based, semi-gloss (Gloss Level 5), MPI #163.
      1) S-W Pro Industrial Acrylic Semi-Gloss.

3.8 INTERIOR PAINTING SCHEDULE

A. CMU Substrates:

1. Latex System:
   a. Prime Coat: Block filler, latex, interior/exterior, MPI #4.
      1) S-W Loxon Block Surfacer.
   b. Topcoats (2 required): Latex, interior eggshell (Gloss Level 2), MPI #44.
      1) S-W ProMar 200 Zero VOC Interior Latex Eg-Shel.

B. Ferrous Metal Substrates:

1. Water-Based Light Industrial Coating System:
   a. Prime Coat: Light industrial primer, water based MPI #107.
      1) S-W Pro Industrial Pro-Cryl Universal Primer.
   b. Topcoats (2 required): Light industrial coating, water based, semi-gloss, MPI #147.
      1) S-W Pro Industrial Acrylic Semi-Gloss.

C. Galvanized Metal Substrates:

1. Water-Based Light Industrial Coating System:
   a. Prime Coat: Light industrial primer, water based MPI #107.
      1) S-W Pro Industrial Pro-Cryl Universal Primer.
   b. Topcoats (2 required): Light industrial coating, water based, gloss, MPI #147.
      1) S-W Pro Industrial Acrylic Semi-Gloss.

2. Water-Based Dry-Fall System:
   a. Topcoats (2 required): Dry-fall, water based, flat, MPI #133.

1) S-W Pro Industrial Waterborne Acrylic Dry-Fall Flat.

D. Gypsum Board Substrates:

1. Latex System:
   a. Prime Coat: Primer sealer, latex, interior, MPI #50.
      1) S-W ProMar 200 Zero VOC Interior Latex Primer.
   b. Topcoats, Walls (2 required): Latex, interior, eggshell, MPI #44.
      1) S-W ProMar 200 Zero VOC Interior Latex Eg-Shel.
   c. Topcoats, Ceilings (2 required): Latex, interior, flat, MPI #53.
      1) S-W ProMar 200 Zero VOC Interior Latex Flat.

2. Epoxy System:
   a. Prime Coat: Primer sealer, latex, interior, MPI #50.
      1) S-W ProMar 200 Zero VOC Interior Latex Primer.
   b. Top Coats (2 required): Epoxy, semi-gloss, MPI #77.
      1) S-W Water-Based Catalyzed Epoxy Semi-Gloss.

END OF SECTION

SECTION 101400 - SIGNAGE

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Interior Room Identification Signs.

B. Work Included: Perform all work necessary to complete and install all sign and graphic products including supports and mounting hardware, as shown on the drawings or inferable therefrom, and/or as specified herein. The Work includes obtaining all necessary permits from applicable agencies.

C. Related Sections include the following:

1. Division 22 Section "Mechanical Identification" for labels, tags, and nameplates for mechanical equipment.
2. Division 26 Sections for electrical service and connections for illuminated signs.
3. Division 26 Section "Electrical Identification" for labels, tags, and nameplates for electrical equipment.
4. Division 26 Section "Interior Lighting" for illuminated Exit signs.

1.2 DEFINITIONS

A. ADA-ABA Accessibility Guidelines: U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities; Architectural Barriers Act (ABA) Accessibility Guidelines."

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Typeface Samples: Submit laser prints of typeface samples with a full character set to match those of the “Typography” section of the Drawings at 72 point size. Produce samples on the same device as that used to produce camera artwork and/or router outlines.

C. Shop Drawings: Show fabrication and installation details for signs.

1. Show sign mounting heights, locations of supplementary supports to be provided by others, adjacent signs that will affect position or layout of subject signs, architectural features such as joints in wall finish materials, and accessories.
2. Depict materials, material grades and thicknesses, finishes, substructure, footings, fabrication joints, corners, edges, intersections, fasteners, and copy composition including letter and line spacing.
3. Prepare details at not less than 1:4 minimum scale with critical points at full scale.
4. Provide message list, typestyles, graphic elements, including tactile characters and Braille, and layout for each sign.

D. Samples for Verification: For each of the following products and for the full range of color, texture, and sign material indicated, of sizes indicated:

1. Acrylic Sheet: 250 mm by 250 mm for each color required.

2. Coatings: 250 mm by 250 mm for each color required. Color samples shall be on similar substrate to finished product and shall be treated with any specified films or coatings.

E. Prototypes: One completed full-scale prototype of a typical sign, fully assembled and identical to the production run:

F. Copy Layouts: Half-size laser or plotter prints on bond paper of all sign faces with actual fabrication-ready formatting. Annotate layouts to indicate location, as per Message Schedule and Sign Location Plan conventions. Output shall be of sufficient resolution that visual integrity of the layout may be inspected. Produce samples on the same device as that used to produce camera artwork and/or router outlines.

G. Sign Message Schedule: Use same designations indicated on Drawings.

H. Qualification Data: For Installer.

I. Maintenance Data: For signs to include in maintenance manuals.

J. Warranty: Special warranty specified in this Section.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Installer must be the Fabricator of products or an employer of workers trained and approved by fabricator.

B. Fabricator Qualifications: The Fabricator must be a Shop that employs skilled workers who custom-fabricate products similar to those required for this Project and whose products have a record of successful in-service performance.

C. Source Limitations for materials: Obtain each material required from one source from a single manufacturer.

D. Regulatory Requirements: Comply with applicable provisions in ADA-ABA Accessibility Guidelines and ICC/ANSI A117.1.

E. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: 25 or less.
2. Smoke-Developed Index: 50 or less.

F. Preinstallation Conference: Conduct conference at Project site.

1.5 STANDARDS

A. Verify sign and copy length for proper fit. Notify Architect in writing prior to fabrication of any messages or translations which to not fit on the specified sign. Do not modify typography to fit signs.

B. All copy noted as Braille shall be Grade 2 Braille to match the performance and use specifications of Title III of the Americans with Disabilities Act, Public Law 101-336. The signage fabricator shall verify accuracy of all Braille messages.

1.6 PROJECT CONDITIONS

A. Field Measurements: Verify dimensions of openings, recesses, wall lengths, clear heights, clear widths, and other relevant dimensions by field measurements before fabrication and indicate measurements on Shop Drawings.

1.7 COORDINATION

A. Coordinate placement of anchorage devices with templates for installing signs.

1.8 WARRANTY

A. Special Warranty: Fabricator's standard form in which fabricator agrees to repair or replace components of signs that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:
   a. Deterioration of materials or finishes beyond normal weathering.
   b. Separation of components due to failure of adhesive or fasteners.

2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Acrylic Sheet: ASTM D 4802, Category A-1 (cell-cast sheet), Type UVA (UV absorbing).

B. Translucent Acrylic Sheet: ASTM D 4802, Category A-1 (cell-cast sheet), with Finish 1 (smooth or polished).

C. Applied Vinyl: Die-cut characters from vinyl film of nominal thickness of with pressure-sensitive adhesive backing, suitable for exterior applications.

D. Opaque Acrylic Sheet: ASTM D 4802, Category A-1 (cell-cast sheet), with Finish 1 (smooth or polished), and 6 mm thick unless otherwise indicated; colors as indicated.

E. Fasteners: Provide screws, bolts, and other fastening devices made from the same material as items being fastened, except provide hot-dip galvanized, stainless-steel, or aluminum fasteners for exterior applications. Provide types, sizes, and lengths to suit installation conditions. Use security fasteners where exposed to view.

1. Machine Screws: comply with Industrial Fastener Institute, use countersunk Phillips flat-head where exposed unless otherwise shown.

F. Adhesives: Furnish adhesives as specified and as manufactured by one of the following, or approved equal:

1. Two-face Tape:
   a. 3M VHB Acrylic Foam Tape 4950.
   b. 3M Double Coated Tape 415 Clear.

2. Silicone-Adhesive: Ready-to-use high performance adhesive:
   a. General Electric GE1200 sealant, translucent, SCS1201
   b. Dow Corning 999-A Silicone Building & Glazing Sealant 999

3. Epoxy: Two-component thermosetting epoxy adhesive with 100% solid content:
   a. 3M DP Scotchweld Adhesives.
   b. Lord Engineered Adhesives.

2.2 DIMENSIONAL CHARACTERS

A. Tactile and Braille Sign: Manufacturer's standard process for producing text and symbols complying with ADA-ABA Accessibility Guidelines and with ICC/ANSI A117.1. Text shall be accompanied by Grade 2 Braille. Produce precisely formed characters with square-cut edges free from burrs and cut marks. Produce Braille dots with domed or rounded shape.

   1. Raised-Copy Thickness: Not less than 0.8 mm.

B. Subsurface Copy: Apply vinyl copy, in thicknesses as indicated in the Specifications, to back face of clear glass panels, as indicated in the Drawings and Specifications, forming panel face to produce precisely formed opaque image. Image shall be free of rough edges.

C. Colored Coatings for Acrylic Sheet: For copy and background colors, provide colored coatings, including inks, dyes, and paints, that are recommended by acrylic manufacturers for optimum adherence to acrylic surface and are UV- and water-resistant for five years for application intended.

2.3 FABRICATION: GENERAL

A. Execute all fabrication such that all edges and corners of finished letter forms and sign substrates are true and clean.

B. Execute all finishes such that all surfaces shall have a smooth even finish free of any irregularities, such as pinholes, orange-peeling, scratches, application marks, or other imperfections.

C. Align letter forms so as to maintain a baseline parallel to the sign format. Maintain margins as specified by sign type layouts.

D. Photo-chemically etch all signs and copy noted on drawings as acid-etched or photopolymer to a depth of 0.8 mm, unless otherwise shown on drawings. Etched surfaces shall be paint-filled in the color noted on drawings. Execute all etching so that all edges and corners of finished copy or graphics are true and clean. Contours of Braille etching shall comply with Braille standards.

E. All engraving shall be on computerized CNC engraving systems.

F. Execute all silk screens from photo-screens or negatives prepared per Specifications and Drawings. Silkscreen mesh shall be 390 or finer. Do not use images from the Contract Documents as camera-ready art.

G. Execute silkscreen printing such that all edges and corners of finished letterforms are true and clean.

H. Use paints of a type made for the surface material on which they will be applied, per manufacturers' recommendations. Identify all paints on shop drawings, together with data describing the methods of application and curing.

I. Include primer coats or other surface pretreatments where recommended by the manufacturer of the paints.

J. Use adhesives as recommended by the manufacturers of the materials specified to be laminated or adhered.

2.4 SIGNAGE APPLICATIONS

A. Accessibility Compliance: All signs are required to comply with ADAAG and ANSI/ICC A 117.1 and applicable building codes, unless otherwise indicated; in the event of conflicting requirements, comply with the most comprehensive and specific requirements.

B. All Signage Types: Unless otherwise indicated:

1. Character Font: Helvetica, Arial, or other sans serif font.
2. Character Case: Upper case only.
3. Background Color: As scheduled.
4. Character Color: Contrasting color.
5. Room numbers and restroom copy shall be accompanied by Grade II braille by means of "VisiTouch Duradot System". Glass or metallic "Durodots" shall have 0.059 inch surface diameter with body of sphere pressure secured below face laminate. Routed boxes or glued on dots are not acceptable.

C. 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.

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. Use injection molded panel signs as specified.
4. Character Height: 5/8 inch, minimum.
5. Doors: Identify with room numbers to be determined later, not the numbers shown on the drawings; where indicated, provide "window" section for replaceable occupant name.
6. Conference and Meeting Rooms: Identify with room names and numbers to be determined later, not those shown on the drawings; where indicated, provide "window" section with sliding "In Use/Not in Use" indicator.
7. Service Rooms: Identify with room names and numbers to be determined later, not those shown on the drawings.
8. Rest Rooms: Identify with pictograms, the names "MEN" and "WOMEN", room numbers to be determined later, and braille. Shall appear on a minimum six (6) inch square, unobstructed field.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of work.

B. Examine walls and partitions for proper backing for directories.

C. Examine walls and partitions for suitable framing depth if recessed directories will be installed.

D. Verify that items, including anchor inserts, are sized and located to accommodate signs.

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

3.2 INSTALLATION

A. General: Install directories in locations and at mounting heights indicated on Drawings. Keep perimeter lines straight, level, and plumb. Provide grounds, clips, backing materials, adhesives, brackets, anchors, trim, and accessories necessary for complete installation.

B. Locate signs and accessories where indicated, using mounting methods of types described and complying with fabricator's written instructions.

1. Install signs level, plumb, and at heights indicated, with sign surfaces free of distortion and other defects in appearance.
2. Interior Wall Signs With Tactile Copy: Install signs in accordance with the following criteria:
   a. At single-leaf doors, install sign adjacent to latch side of door. Where a glass sidelight is adjacent to the latch side of the door, install sign on wall surface adjacent to the glass sidelight.
   b. At double-leaf doors with one active leaf, install sign on the inactive leaf in the center of the leaf, at the height indicated in the Drawings.
   c. At double-leaf doors with two active leaves, install sign to the right of the right-hand door. Where a glass sidelight is adjacent to the right-hand door, install sign on wall surface adjacent to the glass sidelight.
   d. Where there is no space at the latch-side of a single-leaf door, or at the right side of double-leaf doors, install signs on nearest adjacent walls.
   e. Locate signs containing tactile characters so that a clear floor space of 460 mm square (centered on the tactile characters) is provided beyond the arc of the door swing, between the closed position and the 45-degree (half-open) position.
   f. Locate to allow approach within 75 mm of sign without encountering protruding objects or standing within swing of door.

C. Wall-Mounted Signs: Comply with fabricator's written instructions except where more stringent requirements apply.

1. Two-Face Tape: Mount signs to smooth, nonporous surfaces. Do not use this method for vinyl-covered or rough surfaces.
2. Silicone-Adhesive Mounting: Attach signs to irregular, porous, or vinyl-covered surfaces.
3. Shim Plate Mounting: Provide 3 mm-thick, concealed aluminum shim plates with predrilled and countersunk holes, at locations indicated, and where other mounting methods are not practicable. Attach plate with fasteners and anchors suitable for secure attachment to substrate. Attach panel signs to plate using method specified above.
4. Mechanical Fasteners: Use non-removable mechanical fasteners placed through predrilled holes. Attach signs with fasteners and anchors suitable for secure attachment to substrate as recommended in writing by sign manufacturer.
5. Signs Mounted on Glass: Provide opaque plate on opposite side of glass to conceal mounting materials. Opaque plate shall match material, color, and dimensions of sign.

D. If no location is provided, obtain instructions from Architect.

3.3 CLEANING AND PROTECTION

A. After installation, clean soiled sign surfaces according to manufacturer's written instructions. Protect signs from damage until acceptance by Owner.

B. Protect all adjacent surfaces from damage during installation.

C. Following installation, remove all traces of visible tapes, adhesives, or wrappings.

END OF SECTION

SECTION 102113.17 - PHENOLIC TOILET COMPARTMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Phenolic core compartment partitions for following applications:
   a. Toilet enclosures.
   b. Urinal screens.

B. Related Requirements:

1. Division 06 Section "Rough Carpentry" for compartment anchorage to frame walls.
2. Division 10 Section "Toilet Accessories" for toilet tissue dispensers, grab bars, purse shelves, and similar accessories mounted on toilet compartments.

1.2 ACTION SUBMITTALS

A. Product Data: Manufacturer's data sheets for each type of product indicated. Include fabrication details, description of materials and finishes.

1. Product Test Reports: When requested by Architect, submit documentation by qualified independent testing agency indicating compliance of products with requirements.

B. Shop Drawings: Include overall product dimensions, floor plan, elevations, sections, details, and attachments to other work. Include choice of options with details.

C. Samples for Verification: Furnish physical sample of material in selected color.

1. Size: 2 by 2 inch in type of finish specified.

1.3 CLOSEOUT SUBMITTALS

A. Maintenance and cleaning instructions.

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications: Approved manufacturer listed in this section, with minimum 5 years experience in the manufacture of toilet compartments.

B. Installers Qualifications: Experienced Installer regularly engaged in installation of toilet compartments for minimum 3 years.

C. Source Limitations: Obtain toilet compartment components and accessories from single manufacturer.

D. Accessibility Requirements: Comply with requirements of ICC/ANSI 117.1, and with requirements of authorities having jurisdiction.

E. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: 30.
2. Smoke-Developed Index: 110.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Do not deliver toilet compartments to site until building is enclosed and HVAC systems are in operation.

1. Deliver toilet compartments in manufacturer's original packaging.
2. Store in an upright condition.

1.6 WARRANTY

A. Special Manufacturer’s Warranty: Provide manufacturer's standard form in which manufacturer agrees to repair or replace products that fail in materials or workmanship during the following period after substantial completion:

1. Phenolic Core Toilet Partitions: Against delamination: 3 years.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

1. Accurate Partitions Corp.
2. Ampco Products, LLC.
3. Bradley Mills.
4. General Partitions Mfg. Corp.
5. Marlite, Inc.

2.2 MATERIALS

A. Phenolic Core: Compressed cellulose impregnated with phenolic resins. Provide smooth material, without creases or ripples.

B. Stainless Steel Sheet: ASTM A 240 or A 666, 300 series.

C. Stainless Steel Castings: ASTM A 743/A 743M.

2.3 PHENOLIC CORE TOILET COMPARTMENTS

A. Toilet Compartment Type:

1. Overhead braced.
   a. Basis of Design Product: Accurate Partitions, Phenolic.

B. Urinal Screen Style:

1. Wall hung with brackets:
   a. Basis of Design Product: Accurate Partitions, Phenolic.

C. Door, Panel, and Pilaster Construction, General: Form edges with 15 degree bevel without crown molding. Finish edges smooth.

1. Provide exposed surfaces free of pitting, visible seams and fabrication marks, stains, telegraphing of core material, or other imperfections.
2. Core Material: Manufacturer's standard solid resin core of thickness required to provide finished thickness for doors, panels and pilasters.

D. Door Construction: 3/4 inch thick.

E. Panel Construction: 1/2 inch thick.

F. Pilaster Construction: 3/4 inch thick.

1. Provide pilaster with mechanically fastened leveling bar reinforcement with stainless steel jack bolt for leveling.

G. Shoes: 4 inches high minimum, Type 304 stainless steel with No. 4 satin brushed finish. Provide concealed retainer clips to attach to pilaster.

H. Urinal-Screen Construction: Matching toilet compartment panel construction

I. Brackets (Fittings):

1. Full-Height (Continuous) Type: Manufacturer's standard design; stainless steel, through-bolt.

J. Phenolic Panel Finish:

1. Facing Sheet Finish: One color and pattern in each room.
2. Color and Pattern: As selected by Architect from manufacturer's full line.
3. Edge Color: Manufacturer's standard.

2.4 HARDWARE AND ACCESSORIES

A. Hardware, Heavy Duty: Manufacturer's heavy-duty stainless steel castings, including stainless steel tamper-resistant fasteners:

1. Hinges: Self-closing surface mounted, wrap-around, through bolted, with gravity cams, adjustable to hold doors open at any angle up to 90 degrees, with emergency access by lifting door. Mount with stainless steel through-bolts.
2. Latch and Keeper: Surface-mounted slide latch with flat rubber-faced combination door strike and keeper, with provision for emergency access, meeting requirements for accessibility at accessible compartments.
3. Coat Hook: Combination hook and rubber-tipped stop, sized to prevent door from hitting compartment-mounted accessories. Provide wall bumper where door abuts wall. Provide formed L-shaped hook without stop at outswing doors. Mount with stainless steel through-bolts.
4. Door Pull: Standard unit on outside of inswing doors. Provide pulls on both sides of outswing doors.

B. Overhead Bracing: Manufacturer's standard continuous extruded aluminum head rail with antigrip profile and in manufacturer's standard finish.

C. Anchorages and Fasteners: Manufacturer's standard exposed fasteners of stainless steel, finished to match the items they are securing, with theft-resistant-type heads. Provide sex-type bolts for through-bolt applications. For concealed anchors, use stainless-steel, hot-dip galvanized-steel, or other rust-resistant, protective-coated steel compatible with related materials.

2.5 FABRICATION

A. Overhead-Braced Units: Provide manufacturer's standard corrosion-resistant supports, leveling mechanism, and anchors at pilasters to suit floor conditions. Provide shoes at pilasters to conceal supports and leveling mechanism.

B. Door Size and Swings: Unless otherwise indicated, provide 26-inch-wide, in-swinging doors for standard toilet compartments and 36-inch-wide, out-swinging doors with a minimum 32-inch-wide clear opening for compartments designated as accessible.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine work area to verify that measurements, substrates, supports, and environmental conditions are in accordance with manufacturer's requirements to allow installation.

1. Proceed with installation once conditions meet manufacturer's requirements.

3.2 INSTALLATION

A. General: Comply with manufacturer's written installation instructions. Install units rigid, straight, level, and plumb. Secure units in position with manufacturer's recommended anchoring devices.

B. Install toilet partitions and screens in spaces with operating, temperature controlled HVAC systems. Shield partitions and screens from direct sunlight.

C. Clearances: Install with clearances indicated on Drawings. Where clearances are not indicated, allow maximum 1/2 inch between pilasters and panels, and 1 inch between panels and walls.

D. Overhead-Braced Units: Secure pilasters to floor and level, plumb, and tighten. Set pilasters with anchors penetrating not less than 1-3/4 inches into structural floor unless otherwise indicated in manufacturer's written instructions. Secure continuous head rail to each pilaster with no fewer than two fasteners. Hang doors to align tops of doors with tops of panels, and adjust so tops of doors are parallel with overhead brace when doors are in closed position.

3.3 ADJUSTING

A. Hardware Adjustment: Adjust and lubricate hardware according to hardware manufacturer's written instructions for proper operation. Set hinges on in-swinging doors to hold doors open approximately 15 degrees from closed position when unlatched. Set hinges on out-swinging doors to return doors to fully closed position.

3.4 FINAL CLEANING

A. Clean partition and screen surfaces with materials and cleansers in accordance with manufacturer's recommendations.

END OF SECTION

SECTION 102226 - FOLDING PANEL PARTITIONS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Manually operated folding partitions.

1.2 SUBMITTALS

A. Product Data:

1. Manufacturer’s schedules, charts, literature and illustrations to indicate the performance, fabrication procedures, product variations, and accessories.
2. Manufacturer's specifications and other data needed to prove compliance with specified requirements.
3. Manufacturer's installation instructions.
4. Manufacturer's operation and maintenance manuals.
5. Test reports: complete report for E90-05

B. Shop Drawings: Show materials, opening sizes, fabrication details, hardware, attachments, related and adjacent work, and finishes.

C. Samples for verification: 6 inch x 6 inch samples showing selected colors for Architect’s approval.

1.3 REFERENCES

A. ASTM International (ASTM)

1. E84, Test Method for Surface Burning Characteristics of Building Materials
2. E90-05, Method for Laboratory Measurement of Airborne-Sound Transmission Loss of Building Partitions
3. E557, Practice for Architectural Application and Installation of Operable Partitions

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Company qualified and factory trained in installing panel folding partitions of the type specified.

B. Acoustical rating: certified by an independent acoustical laboratory in accordance with ASTM E90-05 test procedure in a full scale 14 feet by 9 feet opening

1.5 WARRANTY

A. Warranty the Work specified herein for two (2) year against becoming unserviceable or causing an objectionable appearance resulting from either defective or nonconforming materials and workmanship.

B. Defects shall include, but not be limited to, the following:

1. Noticeable deterioration of finish, cracking, or joint failure

2. Loose or missing parts
3. Rupture of suspension system
4. Noisy or difficult operation

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Approved Manufacturers:

1. Hufcor, Inc.
2. Moderco, Inc.
3. Modernfold, Inc.
4. Advanced Equipment Corp.

B. Basis-of-Design: Hufcor 632 Series with Type 38 aluminum track.

2.2 MATERIALS

A. Operation: manually operated

B. Panel Configuration:

1. Paired panels, side stacking.
2. Final closure: Executed by seal to back of pocket to preserve acoustical rating

C. Panels:

1. Nominal 3- inches thick, one piece, steel.
2. Frame: 16 gauge steel, minimum, painted.
3. Vertical astragal: interlocking steel or aluminum, tongue and groove configuration, acoustically active. Lead panel shall seal against wall without use of wall mounted jamb.
4. Vertical Trim: aluminum protective edge. Color as scheduled.
5. Surface: Fabric as scheduled, Class A, flame resistant backing.

D. Acoustical Rating - STC 50, minimum.

E. Sound Seals:

1. Top, Horizontal: continuous contact extruded vinyl.
2. Bottom, Horizontal: 1 inch to 2 inch retractable exerting pressure equal to tested specimen.

F. Suspension System: Aluminum or steel track supported by adjustable steel hanger rods. Provide steel radial type ball-bearing wheels encased in molded polymer tires. Provide integral support and trim for adjoining ceiling, soffit, or plenum sound barrier.

G. Pass Doors (where indicated): A.D.A. compliant, nominally 3’-0” wide by 7’-0” high, material and thickness same as panels. Equip with butt-type hinges and positive latches with drop cup and ring pulls. Provide locks, inset self-illuminated exit signs, automatic door closers.

H. Pocket Doors (where indicated): 3-piece flush doors manufactured of the same materials as the panels. Finish of exposed surfaces shall match adjacent wall finish. Provide standard butt-type hinges. Provide 90 degree door stop.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Before commencing installation, examine the opening. Surfaces shall be clean and dry. Concrete surfaces shall be free of excess mortar and lumps. Metal surfaces shall be free of grease, oil, dirt, rust, corrosion and welding slag, without sharp edges.

B. Verify that rough opening is correct and had been prepared to conform to ASTM E557.

3.2 PREPARATION

A. Open containers and verify that all required parts are available and undamaged before disposing of containers.

B. Arrange materials in proper sequence to conform to manufacturer's information and installation instructions.

3.3 INSTALLATION

A. Install panel folding partitions in accordance with manufacturer's instructions using qualified factory trained installers.

B. Lubricate all bearing and sliding parts and adjust for smooth and easy operation. Adjust hardware for accurate fit and smooth, easy operation.

C. Apply perimeter caulking and trim as required.

3.4 CLEANING

A. Clean exposed surfaces to remove soil without using abrasive cleaners or solutions containing corrosive solvents in accordance with manufacturer's instructions.

B. Remove debris caused as a result of Work of this Section.

3.5 FIELD QUALITY CONTROL

A. Light-Leakage Test: Illuminate one side of partition installation and observe vertical joints and top and bottom seals for voids; adjust partitions for acceptable fit.

3.6 DEMONSTRATION

A. After all adjustments, lubrications and clean-up, the installer shall demonstrate and instruct the proper operation, function and maintenance procedures for the panel folding partitions.

B. Deliver operation and maintenance manuals to the Owner.

END OF SECTION

SECTION 102800 - TOILET ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Toilet room accessories.
2. Underlavatory guards.
3. Custodial accessories.

B. Owner-Furnished Material: As scheduled on Drawings; all Owner-furnished items are to be installed by Contractor.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include the following:

1. Construction details and dimensions.
2. Anchoring and mounting requirements, including requirements for cutouts in other work and substrate preparation.
3. Material and finish descriptions.
4. Features that will be included for Project.
5. Manufacturer's warranty.

B. Samples: Full size, for each accessory item to verify design, operation, and finish requirements.

1. Approved full-size Samples will be returned and may be used in the Work.

C. Product Schedule: Indicating types, quantities, sizes, and installation locations by room of each accessory required.

1. Identify locations using room designations indicated.
2. Identify products using designations indicated.

1.3 INFORMATIONAL SUBMITTALS

A. Warranty: Sample of special warranty.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For toilet and bath accessories to include in maintenance manuals.

1.5 QUALITY ASSURANCE

A. Source Limitations: For products listed together in the same Part 2 articles, obtain products from single source from single manufacturer.

1.6 COORDINATION

A. Coordinate accessory locations with other work to prevent interference with clearances required for access by people with disabilities, and for proper installation, adjustment, operation, cleaning, and servicing of accessories.

B. Deliver inserts and anchoring devices set into concrete or masonry as required to prevent delaying the Work.

1.7 WARRANTY

A. Special Mirror Warranty: Manufacturer's standard form in which manufacturer agrees to replace mirrors that develop visible silver spoilage defects and that fail in materials or workmanship within specified warranty period.

1. Warranty Period: 15 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Stainless Steel: ASTM A 666, Type 304, 0.031-inchminimum nominal thickness unless otherwise indicated.

B. Brass: ASTM B 19, flat products; ASTM B 16/B 16M, rods, shapes, forgings, and flat products with finished edges; or ASTM B 30, castings.

C. Steel Sheet: ASTM A 1008/A 1008M, Designation CS (cold rolled, commercial steel), 0.036-inchminimum nominal thickness.

D. Galvanized-Steel Sheet: ASTM A 653/A 653M, with G60hot-dip zinc coating.

E. Galvanized-Steel Mounting Devices: ASTM A 153/A 153M, hot-dip galvanized after fabrication.

F. Fasteners: Screws, bolts, and other devices of same material as accessory unit and tamper-and-theft resistant where exposed, and of galvanized steel where concealed.

G. Chrome Plating: ASTM B 456, Service Condition Number SC 2 (moderate service).

H. Mirrors: ASTM C 1503, Mirror Glazing Quality, clear-glass mirrors, nominal 6.0 mm thick.

I. ABS Plastic: Acrylonitrile-butadiene-styrene resin formulation.

2.2 TOILET ROOM ACCESSORIES

A. Basis-of-Design Product: Subject to compliance with requirements, provide products scheduled on Drawings or comparable products by one of the following:

1. A & J Washroom Accessories, Inc.
2. American Specialties, Inc.
3. Bobrick Washroom Equipment, Inc.

4. Bradley Corporation.

2.3 UNDERLAVATORY GUARDS

A. Underlavatory Guards: As scheduled on Drawings.

2.4 CUSTODIAL ACCESSORIES

A. Basis-of-Design Product: Subject to compliance with requirements, provide products scheduled on Drawings or comparable products by one of the following:

1. A & J Washroom Accessories, Inc.
2. American Specialties, Inc.
3. Bobrick Washroom Equipment, Inc.
4. Bradley Corporation.

2.5 FABRICATION

A. General: Fabricate units with tight seams and joints, and exposed edges rolled. Hang doors and access panels with full-length, continuous hinges. Equip units for concealed anchorage and with corrosion-resistant backing plates.

B. Keys: Provide universal keys for internal access to accessories for servicing and resupplying. Provide minimum of six keys to Owner's representative.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install accessories according to manufacturers' written instructions, using fasteners appropriate to substrate indicated and recommended by unit manufacturer. Install units level, plumb, and firmly anchored in locations and at heights indicated.

B. Grab Bars: Install to withstand a downward load of at least 250 lbf, when tested according to ASTM F 446.

3.2 ADJUSTING AND CLEANING

A. Adjust accessories for unencumbered, smooth operation. Replace damaged or defective items.

B. Remove temporary labels and protective coatings.

C. Clean and polish exposed surfaces according to manufacturer's written recommendations.

END OF SECTION 102800

SECTION 104100 - EMERGENCY ACCESS CABINETS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Fire Department Rapid Entry System.

B. Accessories.

1.2 SUBMITTALS

A. Product Data: Provide operational features, color and finish, anchorage details, and tamper switch alarm connection.

B. Manufacturer's Installation Instructions: Indicate special criteria and wall opening coordination requirements.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Fire Department Rapid Entry System:

1. DoorKing, Inc.; Product Lock Box No. 1400: www.doorking.com.
2. Knox Company; Product KnoxBox 3200: www.knoxbox.com
3. GE; Product SupraSafe 2HSR/TS: www.suncityfire.com
4. Substitutions: See Section 012500 - Substitution Procedures.

2.2 EMERGENCY ACCESS CABINETS

A. Description: Steel box with keyed, weatherproof, hinged access door.

1. Size: 5.375 inch H by 4.5 inch W by 3.675 inch D
2. Box: 14 gauge steel
3. Color: Red
4. Mounting: Recessed and surface as indicated.

2.3 ACCESSORIES

A. Graphic Identification: FIRE DEPARTMENT, decal on box.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify rough openings for cabinet are correctly sized and located.

3.2 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install cabinets plumb and level recessed in wall opening.

C. Secure rigidly in place.

D. Position cabinet signage at face of box.

END OF SECTION

SECTION 104413 - FIRE PROTECTION CABINETS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Fire protection cabinets for the following:
   a. Portable fire extinguishers.

B. Related Sections:

1. Section 104416 "Fire Extinguishers."

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for fire protection cabinets.

1. Fire Protection Cabinets: Include roughing-in dimensions, details showing mounting methods, relationships of box and trim to surrounding construction, door hardware, cabinet type, trim style, and panel style.

B. Shop Drawings: For fire protection cabinets. Include plans, elevations, sections, details, and attachments to other work.

C. Samples for Initial Selection: For each type of fire protection cabinet indicated.

D. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below:

1. Size: 6 by 6 inches square.

E. Product Schedule: For fire protection cabinets. Coordinate final fire protection cabinet schedule with fire extinguisher schedule to ensure proper fit and function.

1.3 QUALITY ASSURANCE

A. Preinstallation Conference: Conduct conference at Project site.

1. Review methods and procedures related to fire protection cabinets including, but not limited to, the following:
   a. Schedules and coordination requirements.
   b. Final locations as required by authorities having jurisdiction.

1.4 COORDINATION

A. Coordinate size of fire protection cabinets to ensure that type and capacity of fire extinguishers indicated are accommodated.

B. Coordinate sizes and locations of fire protection cabinets with wall depths.

C. Source Limitations: Obtain fire-protection cabinets from single source from single manufacturer.

1.5 SEQUENCING

A. Apply vinyl lettering on field-painted, fire protection cabinets after painting is complete.

PART 2 - PRODUCTS

2.1 FIRE PROTECTION CABINET

A. Cabinet Type: Suitable for fire extinguisher. Interior. ADA Compliant.

1. Products: Subject to compliance with requirements, provide Cosmopolitan Series as manufactured by JL Industries, Inc.,_ or comparable by one of the following:
   a. Larsen's Manufacturing Company.
   b. Potter Roemer Fire Pro.

B. Size: 27 inches by 12 inches by 7-3/4 inches inside tub dimension.

C. Cabinet Construction: Nonrated.

D. Cabinet Material: Cold rolled steel sheet.

E. Semi-recessed Cabinet: One-piece combination trim and perimeter door frame overlapping surrounding wall surface with exposed trim face and wall return at outer edge (backbend).

1. Rolled-Edge Trim: 2-1/2-inch backbend depth.

F. Cabinet Trim Material: Same material and finish as door.

G. Door Material: Stainless steel sheet.

H. Door Style: Vertical duo panel with frame.

I. Door Glazing: Tempered break glass.

J. Door Hardware: Manufacturer's standard door-operating hardware of proper type for cabinet type, trim style, and door material and style indicated.

1. Provide recessed door pull and friction latch.
2. Provide continuous hinge, of same material and finish as trim, permitting door to open 180 degrees.

K. Accessories:

1. Mounting Bracket: Manufacturer's standard steel, designed to secure fire extinguisher to fire protection cabinet, of sizes required for types and capacities of fire extinguishers indicated, with plated or baked-enamel finish.
2. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location.
   a. Identify fire extinguisher in fire protection cabinet with the words "FIRE EXTINGUISHER."
      1) Location: Applied to cabinet door.
      2) Application Process: Pressure-sensitive vinyl letters.

3) Lettering Color: Red.
4) Orientation: Vertical.

b. Identify bracket-mounted extinguishers with the words “ÓÓFIRE EXTINGUISHER."
1) Location: Applied to wall surface.
2) Application Process: Pressure-sensitive vinyl letters.
3) Lettering Color: Red.

L. Materials:

1. Cold-Rolled Steel: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B.
a. Finish: Baked enamel or powder coat.
b. Color: White.

2. Stainless-Steel Sheet: ASTM A 666, Type 304.
a. Finish: No. 4 directional satin finish.

3. Tempered Break Glass: ASTM C 1048, Kind FT, Condition A, Type I, Quality q3, 1.5 mm thick.

2.2 FABRICATION

A. Fire Protection Cabinets: Provide manufacturer's standard box (tub) with trim, frame, door, and hardware to suit cabinet type, trim style, and door style indicated.

1. Weld joints and grind smooth.
2. Provide factory-drilled mounting holes.

B. Cabinet Doors: Fabricate doors according to manufacturer's standards, from materials indicated and coordinated with cabinet types and trim styles selected.

1. Fabricate door frames with tubular stiles and rails and hollow-metal design, minimum 1/2 inch thick.
2. Miter and weld perimeter door frames.

C. Cabinet Trim: Fabricate cabinet trim in one piece with corners mitered, welded, and ground smooth.

2.3 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces of fire protection cabinets from damage by applying a strippable, temporary protective covering before shipping.

C. Finish fire protection cabinets after assembly.

D. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.4 STAINLESS-STEEL FINISHES

A. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.

B. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.

1. Run grain of directional finishes with long dimension of each piece.
2. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.
3. Directional Satin Finish: No. 4.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine walls and partitions for suitable framing depth and blocking where recessed cabinets will be installed.

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

3.2 PREPARATION

A. Prepare recesses for recessed fire protection cabinets as required by type and size of cabinet and trim style.

3.3 INSTALLATION

A. General: Install fire protection cabinets in locations and at mounting heights indicated or, if not indicated, at heights acceptable to authorities having jurisdiction.

1. Fire Protection Cabinets: 54 inches above finished floor to top of cabinet.

B. Fire Protection Cabinets: Fasten cabinets to structure, square and plumb.

1. Unless otherwise indicated, provide semi-recessed fire protection cabinets. .
2. Fasten mounting brackets to inside surface of fire protection cabinets, square and plumb.

C. Identification: Apply vinyl lettering at locations indicated.

3.4 ADJUSTING AND CLEANING

A. Remove temporary protective coverings and strippable films, if any, as fire protection cabinets are installed unless otherwise indicated in manufacturer's written installation instructions.

B. Adjust fire protection cabinet doors to operate easily without binding. Verify that integral locking devices operate properly.

C. On completion of fire protection cabinet installation, clean interior and exterior surfaces as recommended by manufacturer.

D. Touch up marred finishes, or replace fire protection cabinets that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by fire protection cabinet and mounting bracket manufacturers.

E. Replace fire protection cabinets that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION

SECTION 104416 - FIRE EXTINGUISHERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes portable, hand-carried fire extinguishers.

B. Related Requirements:

1. Section 104413 "Fire Protection Cabinets."

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product. Include rating and classification, material descriptions, dimensions of individual components and profiles, and finishes for fire extinguisher.

B. Product Schedule: For fire extinguishers. Coordinate final fire-extinguisher schedule with fire-protection cabinet schedule to ensure proper fit and function.

1.3 INFORMATIONAL SUBMITTALS

A. Warranty: Sample of special warranty.

1.4 COORDINATION

A. Coordinate type and capacity of fire extinguishers with fire-protection cabinets to ensure fit and function.

1.5 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace fire extinguishers that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:
   a. Failure of hydrostatic test according to NFPA 10.
   b. Faulty operation of valves or release levers.

2. Warranty Period: Six years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. NFPA Compliance: Fabricate and label fire extinguishers to comply with NFPA 10, "Portable Fire Extinguishers."

B. Fire Extinguishers: Listed and labeled for type, rating, and classification by an independent testing agency acceptable to authorities having jurisdiction.

1. Provide initial inspection tag for each extinguisher, with all monthly fields signed clearly.
   a. Inspection tags shall be dated within 30 days of Substantial Completion.

C. Source Limitations: Obtain fire extinguishers from single source from single manufacturer.

2.2 PORTABLE, HAND-CARRIED FIRE EXTINGUISHERS

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

1. Badger Extinguishers.
2. JL Industries.
3. Kidde
4. Larsen's Manufacturing Company.
5. Potter Roemer Fire Pro.
6. ULine.

B. Fire Extinguishers, General:

1. Handles and Levers: Manufacturer's standard.
2. Instruction Labels: Include pictorial marking system complying with NFPA 10, Appendix B, and bar coding for documenting fire-extinguisher location, inspections, maintenance, and recharging.

C. Extinguishers in Fire Protection Cabinets: Provide extinguisher for each cabinet:

1. Regular Dry-Chemical Type in Steel Container: UL-rated 4A-80B:C, 10-lb nominal capacity conforming to JL Industries Cosmic Series, with sodium bicarbonate-based dry chemical in enameled-steel container.

D. Wall-Mounted Extinguishers: Mount extinguishers on walls in mechanical rooms and elsewhere as indicated on drawings or as required by the authorities having jurisdiction:

1. Regular Dry-Chemical Type in Steel Container: UL-rated 4A-80B:C, 10-lb nominal capacity conforming to JL Industries Cosmic Series, with sodium bicarbonate-based dry chemical in enameled-steel container.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine fire extinguishers for proper charging and tagging.

1. Remove and replace damaged, defective, or undercharged fire extinguishers.

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

3.2 INSTALLATION

A. General: Install fire extinguishers in locations indicated and in compliance with requirements of authorities having jurisdiction and as directed by Owner.

B. Install fire extinguisher cabinets in openings prepared in accordance with manufacturer's printed instructions.

END OF SECTION

SECTION 105129 - PHENOLIC LOCKERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Phenolic core lockers.
2. Locker benches.

1.2 SUBMITTALS

A. Product Data: Manufacturer's data sheets for each type of product indicated. Include fabrication details, description of materials and finishes.

1. Product Test Reports: When requested by Architect, submit documentation by qualified independent testing agency indicating compliance of products with requirements.

B. Shop Drawings: Include overall product dimensions, floor plan, elevations, sections, details, and attachments to other work. Include choice of options with details.

1. Show details full size.
2. Show locations and sizes of furring, blocking, and hanging strips, including concealed blocking and reinforcement specified in other Sections.
3. Show locations and sizes of cutouts and holes for items installed in phenolic lockers.
4. Show fillers, trim, and accessories.
5. Show locker numbering sequence.

C. Samples for Verification: For the following products, in manufacturer's standard size:

1. Lockers and equipment.
2. Locker benches.

D. Qualification Data: For qualified Installer.

E. Maintenance Data: For adjusting, repairing, and replacing wood locker doors and latching mechanisms to include in maintenance manuals.

F. Warranty: Sample of special warranty.

1.3 QUALITY ASSURANCE

A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.

B. Source Limitations: Obtain lockers and accessories from single source from single manufacturer.

C. Regulatory Requirements: Where lockers are indicated to comply with accessibility requirements, comply with the U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA) and Architectural Barriers Act (ABA) Accessibility Guidelines for Buildings and Facilities." and ICC/ANSI A117.1.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Do not deliver phenolic lockers until painting and similar operations that could damage lockers have been completed in installation areas. If lockers must be stored in other-than-installation areas, store only in areas where environmental conditions are same as that in final installation location and comply with requirements specified in "Project Conditions" Article.

1.5 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install phenolic lockers until spaces are enclosed and weathertight, wet work in spaces is complete and dry, and temporary HVAC system is operating and maintaining ambient temperature between 60 and 90 deg F during the remainder of the construction period.

B. Field Measurements: Verify actual dimensions of concealed framing, blocking, and reinforcements that support phenolic lockers by field measurements before fabrication.

1.6 COORDINATION

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

1.7 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of phenolic lockers that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:
   a. Structural failures.
   b. Faulty operation of locks or hardware.
   c. Deterioration of finishes and materials beyond normal use.
   d. Delamination of laminate and backer materials.

2. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design: Subject to compliance with requirements, provide phenolic lockers manufactured by Columbia Lockers, or comparable products by one of the following:

1. ASI Storage Solutions.
2. Prospec US Inc.

B. Configurations: Double tier.

2.2 PERFORMANCE REQUIREMENTS

A. Accessibility Standard: For lockers and locker benches indicated to be accessible, comply with applicable provisions in the USDOJ's "2010 ADA Standards for Accessible Design".

2.3 MATERIALS

A. Phenolic Core: Compressed cellulose impregnated with phenolic resins. Provide smooth material, without creases or ripples.

B. Stainless Steel Sheet: ASTM A 240 or A 666, 300 series.

C. Stainless Steel Castings: ASTM A 743/A 743M.

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

E. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage.

1. Provide nonferrous-metal or hot-dip galvanized anchors and inserts on inside face of exterior walls and elsewhere as indicated on Drawings.
2. Provide toothed-steel or lead-expansion sleeves for drilled-in-place anchors.

2.4 PHENOLIC LOCKERS

A. Construction Style: Flush overlay.

B. Locker Body: Fabricated from phenolic core panels, 1/2 inch thick.

C. Locker Doors: Fabricated from phenolic core panels, 1/2 inch thick.

D. End, Corner, and Filler Panels: Match style, material, construction, and finish of phenolic doors.

E. Shelves: Fabricated from phenolic core panels, 1/2 inch thick; adjustable.

F. Phenolic Colors: As indicated.

2.5 PHENOLIC LOCKER HARDWARE

A. General: Provide manufacturer's standard phenolic locker hardware complying with the requirements in this Section.

B. Hinges: Stainless steel, continuous.

C. Limiting Arm: Stainless steel arm limiting opening of door to no more than 90 degrees.

D. Locks: Combination padlocks, provided by users.

E. Accessible Handle: Stainless steel, fixed, graspable lever handle and rose trim; surface mounted.

F. Shelf Rests: BHMA A156.9, B04013.

G. Hooks: Manufacturer’s standard, ball-pointed stainless steel; attach hooks with at least two fasteners.

1. Provide one double-prong ceiling hook and two single-prong wall hooks for each locker.

H. Exposed Hardware Finishes: Satin stainless steel unless otherwise indicated.

2.6 LOCKER ACCESSORIES

A. Number Plates: Manufacturer’s standard black acrylic number plates. Identify lockers with engraved numbers in sequence indicated on Drawings.

2.7 LOCKER BENCHES

A. Provide bench units with overall assembly height of 17-1/2 inches.

B. Bench Tops: Manufacturer's standard one-piece units, with rounded corners and edges.

1. Size: Provide 20- to 24-inch- wide tops where accessible benches are indicated.
2. Laminated clear hardwood with one coat of clear sealer on all surfaces and one coat of clear lacquer on top and sides.

C. Fixed-Bench Pedestals: Manufacturer's standard supports, with predrilled fastener holes for attaching bench top and anchoring to floor, complete with fasteners and anchors, and as follows:

1. Tubular Steel:
   a. 1-1/4-inch- diameter steel tubing, with 0.1265-inch- thick steel flanges welded at top and base; with baked-enamel finish; anchored with exposed fasteners.
      1) Color: As selected by Architect from manufacturer's full range.

2.8 FABRICATION

A. Fabricate each phenolic locker with shelves, an individual door and frame, an individual top, a bottom, and a back, and with common intermediate uprights separating compartments.

1. Fabricate phenolic lockers to dimensions, profiles, and details indicated.
2. Ease edges of phenolic core members to 1/16-inch radius.
3. Fabricate door corners to 1/4 inch radius.

B. Fabricate components square, rigid, without warp, and with finished faces flat and free of scratches and chips. Accurately machine components for attachments in factory. Make joints tight and true.

1. Fabricate phenolic lockers using manufacturer's standard construction. Dado side panels to receive shelving except where indicated to be adjustable.

C. Accessible Lockers: Fabricate as follows:

1. Locate bottom shelf no lower than 15 inches above the floor.
2. Where hooks, coat rods, or additional shelves are provided, locate no higher than 48 inches above the floor.

D. Venting: Fabricate phenolic lockers with space between doors and locker assembly of not less than 1/4 inch.

E. Number Plates: Inlay number plates flush in each locker door, near top, centered.

F. Complete fabrication, including assembly, finishing, and hardware application, to maximum extent possible, before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.

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

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine walls, floors, and support bases, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting phenolic locker installation.

B. Verify that furring is attached to concrete and masonry walls that are to receive phenolic lockers.

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

3.2 PREPARATION

A. Before installing phenolic lockers, examine factory-fabricated work for completeness and complete work as required, including removal of packing.

3.3 INSTALLATION

A. Install phenolic lockers level, plumb, and true; use concealed shims.

B. Connect groups of lockers together with manufacturer's standard fasteners, through predrilled holes, with no exposed fasteners on face frames. Fit lockers accurately together to form flush, tight, hairline joints.

C. Install phenolic lockers without distortion so doors fit openings properly and are accurately aligned. Adjust hardware to center doors in openings, providing unencumbered operation. Complete installation of hardware and accessory items as indicated.

1. Installation Tolerance: No more than 1/8 inch in 96-inch sag, bow, or other variation from a straight line. Shim as required with concealed shims.

D. Scribe and cut corner and filler panels to fit adjoining work using fasteners concealed where practical. Repair damaged finish at cuts.

E. Install number plates after phenolic lockers are in place.

1. Attach number plate on each wood locker door, near top, centered, with at least two screws with finish matching number plate.

F. Fixed Benches: Provide no fewer than two pedestals for each bench, uniformly spaced not more than 72 inches apart. Securely fasten tops of pedestals to undersides of bench tops, and anchor bases to floor.

3.4 ADJUSTING, CLEANING, AND PROTECTING

A. Clean, lubricate, and adjust hardware. Adjust doors to operate easily without binding.

B. Protect phenolic lockers from damage, abuse, dust, dirt, stain, or paint. Do not permit use during construction.

C. Touch up marred finishes, or replace lockers that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by phenolic locker manufacturer.

END OF SECTION

SECTION 107300 - ALUMINUM WALKWAY COVERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Prefabricated aluminum canopies in locations indicated on drawings.

1.2 PERFORMANCE REQUIREMENTS

A. General: Design, fabricate, and install walkway covers to withstand loads from gravity, wind, ponding, drift, and structural movement, including thermally induced movement; and to resist, without failure, other conditions of in-service use, including exposure to weather.

B. Structural Performance: Provide walkway covers capable of withstanding the effects of gravity loads and the following loads and stresses within limits and under conditions indicated.

1. Wind Loads: Determine loads based on the following minimum design wind pressures:
   a. Uniform pressure of 20 lbf/sq. ft., acting upward or downward.

C. Thermal Movements: Provide walkway covers that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, overstressing of components, failure of connections, tearing of fabric, and other detrimental effects. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

1.3 SUBMITTALS

A. Product Data: Include styles, material descriptions, construction details, fabrication details, dimensions of individual components and profiles, hardware, fittings, mounting accessories, features, finishes, and operating instructions for awnings.

B. Shop Drawings: Show location and extent of walkway covers. Include elevations, sections, and details not shown in Product Data. Show materials, fabrication, dimensions, mounting heights, connections, anchorages, installation details, attachments to other work, operational clearances, and relationship to adjoining work. Show colors and graphic layout and content.

1. Show locations for blocking, reinforcement, and supplementary structural support to be provided by others.
2. For installed products indicated to comply with design loads, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation. Calculate requirements for supporting walkway covers. Verify capacity of members and connections to support loads and verify loads, point reactions, and locations for attachment of awnings to structure with those indicated on Drawings.

C. Samples for Verification: For each of the following products and for the full range of color, texture, and pattern variations required, prepared on Samples of size indicated below. If finishes involve normal color and texture variations, include sample sets showing the full range of variations expected.

1. Frame Finish: Not less than 6-inch lengths.

D. Welding certificates.

E. Qualification Data: For fabricator and professional engineer.

F. Research/Evaluation Reports: For anchors and fasteners.

1.4 QUALITY ASSURANCE

A. Fabricator Qualifications: Shop that employs skilled workers who custom-fabricate products similar to those required for this Project and whose products have a record of successful in-service performance.

B. Source Limitations: Obtain walkway covers through one source from a single manufacturer.

C. Welding: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code--Steel."
2. AWS D1.2, "Structural Welding Code--Aluminum."

1.5 PROJECT CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit installation of walkway covers in exterior locations to be performed according to manufacturers' written instructions and warranty requirements.

B. Field Measurements: Where awning installation is indicated to fit to other work, verify dimensions of other work by field measurements before fabrication and indicate measurements on Shop Drawings. Allow clearances for fenestration operation throughout the entire operating range. Notify Architect of discrepancies. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1.6 CONTRACTOR’S RESPONSIBILITIES

A. As scope and performance documents, the Drawings and Specifications do not necessarily indicate or describe all the work required for the performance and completion of the Work. Contracts will be let on the basis of such documents with the understanding that the Contractor shall furnish and install the items required for proper completion of the Work without adjustment to price or schedule. Work shall be of sound, quality construction and the Contractor shall be solely responsible for the inclusions of adequate labor and materials to cover the proper and timely fabrication and installation of the aluminum walkway cover indicated, described, or implied.

B. As a performance specification, the criteria for the solution of structurally sound aluminum walkway cover indicated on the Drawings or specified herein are the sole purpose of defining the design intent and performance requirements. The details shown are intended to emphasize the acceptable profiles and performance requirements for this Project. To avoid any misunderstanding or lack of interpretation, the Contractor is hereby advised that the responsibility for the aluminum walkway cover is totally his and that designs and resolutions proposed in the Contractor’s shop drawings, structural calculations, and related documentation shall be demonstrated throughout the Work and warranty period specified or required.

C. Design proposal submissions which follow exactly the details indicated on the Drawings for the aluminum walkway cover, will not relieve the Contractor of his responsibility for the design, fabrication, erection, or performance of the Work of this Section.

D. In the event of a controversy over the design, the decision of the Architect will take precedence.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design: Provide walkway covers by Avadek Walkway Cover Systems & Canopies; www.avadek.com, or comparable product by one of the following:

1. Aluminum Techniques, Inc.; www.aluminumtechniques.com.
2. Architectural Fabrication, Inc.; www.arch-fab.com.
3. Dittmer Architectural Aluminum; www.ditt-deck.com.
4. Peachtree Protective Covers, Inc.; www.peachtreecovers.com.

2.2 MATERIALS

A. General: All aluminum shapes shall be sized and connections designed to meet or exceed specific project design load requirements, and as indicated in the drawings.

B. Aluminum components shall be 6063-T6 Alloy Extruded aluminum.

C. Structure shall be designed by the manufacturer to withstand walking on top, heavy hail, and winds in the configurations shown on drawings.

D. Provide concealed drainage from deck into columns.

E. Flashing shall be 0.040 inch aluminum fabricated to prevent leakage of water between canopy and adjacent structures, where applicable.

F. Roof Deck: Shall be of size and depth recommended by the manufacturer to suit application, intended use, requirements of building code authorities having jurisdiction, and shall interlock in a homogeneous structural unit, with joint designed and fabricated into a structurally rigid shape which is self-flashing.

G. Expansion Joints: Provide expansion joints as required. Expansion joints shall have no metal to metal contact.

H. Horizontal U-Beams and vertical tube columns shall be sizes recommended by the manufacturer to suit application, intended use, and requirements of building code authorities having jurisdiction, and shall be attached with concealed fasteners.

I. Finish:

1. High-Performance Organic Finish: 2-coat fluoropolymer finish complying with AAMA 2604 AAMA 2605 and containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
2. Color and Gloss: To be selected by Architect from manufacturer's standard colors.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for supporting members, blocking, inserts, installation tolerances, and other conditions affecting performance.

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

3.2 INSTALLATION, GENERAL

A. General: Install walkway covers at locations and in position indicated, securely connected to supports, free of rack, and in proper relation to adjacent construction. Use mounting methods of types described and in compliance with Shop Drawings and fabricator's written instructions.

B. Install walkway covers after other finishing operations, including joint sealing and painting, have been completed.

C. Weld frame connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations.

1. Field Welding: Comply with the following requirements:
   a. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
   b. Obtain fusion without undercut or overlap.
   c. Remove welding flux immediately.
   d. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

D. Anchoring to In-Place Construction: Use anchors, fasteners, fittings, hardware, and installation accessories where necessary for securing awnings to structural support and for properly transferring load to in-place construction.

E. Corrosion Protection: Coat concealed surfaces of aluminum that will come into contact with grout, concrete, masonry, wood, or dissimilar metals with a heavy coat of bituminous paint.

F. Coordinate awning installation with flashing and joint-sealant installation so these materials are installed in sequence and manner that prevent exterior moisture from passing through completed exterior wall and roof assemblies.

3.3 CLEANING AND PROTECTION

A. Clean walkway cover surfaces after installation, according to manufacturer's written instructions.

B. Touchup Painting: Immediately after erection, clean field welds, connections, and abraded areas. Paint uncoated and abraded areas with same or compatible material as used for shop-applied finish painting.

C. Apply by brush or spray to provide a minimum 2.0-mil dry film thickness.

D. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer that ensure that walkway covers are without damage or deterioration at time of Substantial Completion.

E. Replace damaged awnings that cannot be repaired, in a manner approved by Architect, before time of Substantial Completion.

END OF SECTION 105300

SECTION 122413 - ROLLER WINDOW SHADES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Manually operated roller shades with single rollers.

B. Related Requirements:

1. Section 061000 "Rough Carpentry" for wood blocking and grounds for mounting roller shades and accessories.
2. Section 079200 "Joint Sealants" for sealing the perimeters of installation accessories for light-blocking shades with a sealant.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include styles, material descriptions, construction details, dimensions of individual components and profiles, features, finishes, and operating instructions for roller shades.

B. Shop Drawings: Show fabrication and installation details for roller shades, including shadeband materials, their orientation to rollers, and their seam and batten locations.

C. Samples for Initial Selection: For each type and color of shadeband material.

1. Include Samples of accessories involving color selection.

D. Samples for Verification: For each type of roller shade.

1. Shadeband Material: Not less than 10 inches square. Mark inside face of material if applicable.
2. Roller Shade: Full-size operating unit, not less than 16 inches wide by 36 inches long for each type of roller shade indicated.
3. Installation Accessories: Full-size unit, not less than 10 inches long.

E. Roller-Shade Schedule: Use same designations indicated on Drawings.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Product Certificates: For each type of shadeband material, signed by product manufacturer.

C. Product Test Reports: For each type of shadeband material, for tests performed by manufacturer and witnessed by a qualified testing agency.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For roller shades to include in maintenance manuals.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Roller Shades: Full-size units equal to 5 percent of quantity installed for each size, color, and shadeband material indicated, but no fewer than two units.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver roller shades in factory packages, marked with manufacturer, product name, and location of installation using same designations indicated on Drawings.

1.7 FIELD CONDITIONS

A. Environmental Limitations: Do not install roller shades until construction and finish work in spaces, including painting, is complete and dry and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

B. Field Measurements: Where roller shades are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication and indicate measurements on Shop Drawings. Allow clearances for operating hardware of operable glazed units through entire operating range. Notify Architect of installation conditions that vary from Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

1. Mechoshade Systems, Inc.
2. Draper, Inc.
3. Hunter-Douglas.
4. Lutron Electronics Co., Inc.

B. Source Limitations: Obtain roller shades from single source from single manufacturer.

2.2 MANUALLY OPERATED SHADES WITH SINGLE ROLLERS

A. Basis-of-Design: Mecho/5 Single Shade as manufactured by MechoShade Systems, Inc.

B. Chain-and-Clutch Operating Mechanisms: With continuous-loop bead chain and clutch that stops shade movement when bead chain is released; permanently adjusted and lubricated.

1. Bead Chains: Stainless steel.
   a. Loop Length: Full length of roller shade.
   b. Limit Stops: Provide upper and lower ball stops.
   c. Chain-Retainer Type: Chain tensioner, jamb mounted.

2. Spring Lift-Assist Mechanisms: Manufacturer's standard for balancing roller-shade weight and lifting heavy roller shades.
   a. Provide for shadebands that weigh more than 10 lb or for shades as recommended by manufacturer, whichever criteria are more stringent.

C. Rollers: Corrosion-resistant steel or extruded-aluminum tubes of diameters and wall thicknesses required to accommodate operating mechanisms and weights and widths of shadebands indicated without deflection. Provide with permanently lubricated drive-end assemblies and idle-end assemblies designed to facilitate removal of shadebands for service.

1. Roller Drive-End Location: Right side of inside face of shade.
2. Direction of Shadeband Roll: Regular, from back of roller.
3. Shadeband-to-Roller Attachment: Manufacturer's standard method.

D. Mounting Hardware: Brackets or endcaps, corrosion resistant and compatible with roller assembly, operating mechanism, installation accessories, and mounting location and conditions indicated.

E. Roller-Coupling Assemblies: Coordinated with operating mechanism and designed to join up to three inline rollers into a multiband shade that is operated by one roller drive-end assembly.

F. Installation Accessories:

1. Recessed Shade Pocket: Rectangular, extruded-aluminum enclosure designed for recessed ceiling installation; with front, top, and back formed as one piece, end plates, and removable bottom closure panel.
   a. Height: Manufacturer's standard height required to enclose roller and shadeband when shade is fully open, but not less than 4 inches.
   b. Provide pocket with lip at lower edge to support acoustical ceiling panel.

2. Closure Panel and Wall Clip: Removable aluminum panel designed for installation at bottom of site-constructed ceiling recess or pocket and for snap-in attachment to wall clip without fasteners.
   a. Closure-Panel Width: 2 inches.

3. Installation Accessories Color and Finish: As selected from manufacturer's full range.

2.3 SHADEBAND MATERIALS

A. Shadeband Material Flame-Resistance Rating: Comply with NFPA 701. Testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

B. Light-Filtering Fabric: Woven 100 percent thermoplastic olefin fabric, stain and fade resistant.

1. Source: Roller-shade manufacturer, type as indicated.
2. Weave: Mesh or basketweave.
3. Openness Factor: As indicated.
4. Color: As indicated.

2.4 ROLLER-SHADE FABRICATION

A. Product Safety Standard: Fabricate roller shades to comply with WCMA A 100.1, including requirements for flexible, chain-loop devices; lead content of components; and warning labels.

B. Unit Sizes: Fabricate units in sizes to fill window and other openings as follows, measured at 74 deg F:

1. Between (Inside) Jamb Installation: Width equal to jamb-to-jamb dimension of opening in which shade is installed less 1/4 inch per side or 1/2-inch total, plus or minus 1/8 inch. Length equal to head-to-sill or -floor dimension of opening in which shade is installed less 1/4 inch, plus or minus 1/8 inch.

PART 3 - EXECUTION

3.1 EXAMINATION

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

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

3.2 ROLLER-SHADE INSTALLATION

A. Install roller shades level, plumb, and aligned with adjacent units according to manufacturer's written instructions.

3.3 ADJUSTING

A. Adjust and balance roller shades to operate smoothly, easily, safely, and free from binding or malfunction throughout entire operational range.

3.4 CLEANING AND PROTECTION

A. Clean roller-shade surfaces after installation, according to manufacturer's written instructions.

B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that roller shades are without damage or deterioration at time of Substantial Completion.

C. Replace damaged roller shades that cannot be repaired, in a manner approved by Architect, before time of Substantial Completion.

END OF SECTION

SECTION 123661 - SIMULATED STONE COUNTERTOPS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Countertops for architectural cabinetwork of the following materials:

1. Quartz resin.

B. Related Sections:

1. Section 064116 “Plastic Laminate-Faced Architectural Cabinets” for plastic laminate countertops.

1.2 SUBMITTALS

A. Product Data: Manufacturer's data sheets on countertop material.

1. Preparation instructions and recommendations.
2. Storage and handling requirements and recommendations.

B. Shop Drawings: Complete details of materials and installation of each type of countertop; combine with shop drawings of cabinets and casework specified in other sections.

C. Verification Samples: For each finish product specified, minimum size 6 inches square, representing actual product, color, and patterns as scheduled.

D. Test Reports: Chemical resistance testing, showing compliance with specified requirements.

E. Installation Instructions: Manufacturer's installation instructions and recommendations.

F. Maintenance Data: Manufacturer's instructions and recommendations for maintenance and repair of countertop surfaces.

1.3 QUALITY ASSURANCE

A. Quality Certification: Provide AWI Quality Certification Program (QCP) inspection report and quality certification of completed work.

1. Provide labels or certificates indicating that the work complies with requirements of AWS Grade or Grades specified.
2. Prior to delivery to the site provide shop drawings with certification labels.
3. Provide labels on each product when required by certification program.
4. Upon completion of installation provide certificate certifying that the installation and products meet the specified requirements.
5. Arrange and pay for inspections required for certification.
6. Replace, repair, or rework all work for which certification is refused.

B. Installer Qualifications: Fabricator.

1.4 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.

1.5 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

2.1 COUNTERTOP ASSEMBLIES

A. Quality Standard: See Section 064116.

B. Natural Quartz and Resin Composite Countertops: Complying with ISFA-2 and NEMA LD 3; orthopthalic 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.

1. Manufacturers:
   a. Cambria: www.cambriausa.com
   b. Okite by Seieffe Corporation; www.okite.us.
   c. Silestone by Cosentino; www.silestoneusa.com.
   d. Wilsonart Quartz Contertops by Wilsonart Americas: www.wilsonart.com.
2. Flat Sheet Thickness: 2 cm.
3. Surface Burning Characteristics: Flame spread 25, maximum; smoke developed 450, maximum; when tested in accordance with ASTM E84.
4. NSF approved for food contact.
5. Finish on Exposed Surfaces: Polished.
6. Color and Pattern: As scheduled.
7. Exposed Edge Treatment: Built up to minimum 1-1/4 inch thick; square edge; use marine edge at sinks.
8. Back and End Splashes: Same as sheet material, square top; 4 inches high.
9. Skirts: Same as sheet material; size as indicated on drawings.
10. Factory fabricate components to the greatest extent practical in sizes and shapes indicated; comply with the MIA Dimension Stone Design Manual.

2.2 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. Marine grade at sinks.

B. Adhesives: Chemical resistant waterproof adhesive as recommended by manufacturer of materials being joined.

C. Joint Sealant: Mildew-resistant FDA/UL recognized silicone sealant in color-matching or clear formulation.

D. Sink/Bowl Hardware: Manufacturer's approved bowl clips, inserts, and fasteners.

2.3 FABRICATION

A. Fabricate in accordance with standards governing fabrication quality that are specified in Section 064116.

B. 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. At solid surfacing, attach 2 inch wide reinforcing strip of solid polymer material under each joint.
3. Fabricate to overhang fronts and ends of cabinets 1 inch except where top butts against cabinet or wall.
4. Prepare all cutouts accurately to size; replace tops having improperly dimensioned or unnecessary cutouts or fixture holes.

C. 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.

D. Wall-Mounted Counters: Provide skirts, aprons, brackets, and braces as indicated on drawings, finished to match as indicated on Drawings.

PART 3 - EXECUTION

3.1 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.

3.2 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.

3.3 INSTALLATION

A. Securely attach countertops to substrate using concealed fasteners. Make flat surfaces level; shim where required.

B. Seal joint between back/end splashes and vertical surfaces.

3.4 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.

3.5 PROTECTION

A. Clean countertops surfaces thoroughly.

B. Protect installed products until completion of project.

C. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION

SECTION 133419 - METAL BUILDING SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Structural steel framing.
2. Metal roof panels.
3. Metal wall panels.
4. Metal building insulation.
5. Accessories.

B. Related Requirements:

1. Section 033000 “Cast-in-Place Concrete” for slabs and foundations.
2. Section 054000 “Cold-Formed Metal Framing” for wind-resisting steel stud framing.
3. Section 055000 “Metal Fabrications” for miscellaneous steel framing and fabrications supporting materials of other Sections.
4. Section 081113 “Hollow Metal Doors and Frames for hollow metal frames installed in metal building systems.
5. Section 083323 "Overhead Coiling Doors" for coiling doors installed in metal building systems.
6. Section 084113 “Aluminum-Framed Entrances and Storefronts for aluminum storefronts and entrance doors installed in metal building systems.
7. Section 084500 "Insulated Translucent Sandwich Panel Assemblies" for translucent sandwich panels installed in metal building systems.

1.2 DEFINITIONS

A. Terminology Standard: See MBMA's "Metal Building Systems Manual" for definitions of terms for metal building system construction not otherwise defined in this Section or in standards referenced by this Section.

1.3 COORDINATION

A. Coordinate sizes and locations of concrete foundations and casting of anchor-rod inserts into foundation walls and footings. Anchor rod installation, concrete, reinforcement, and formwork requirements are specified in Section 033000 "Cast-in-Place Concrete."

B. Coordinate installation of metal roof and wall panel assemblies, rain drainage work, flashing, trim, supports, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review methods and procedures related to metal building systems including, but not limited to, the following:
   a. Condition of foundations and other preparatory work performed by other trades.
   b. Structural load limitations.

c. Construction schedule. Verify availability of materials and erector's personnel, equipment, and facilities needed to make progress and avoid delays.
d. Required tests, inspections, and certifications.
e. Unfavorable weather and forecasted weather conditions and impact on construction schedule.

2. Review methods and procedures related to metal roof panel assemblies including, but not limited to, the following:
   a. Compliance with requirements for purlin and rafter conditions, including flatness and attachment to structural members.
   b. Structural limitations of purlins and rafters during and after roofing.
   c. Flashings, special roof details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that will affect metal roof panels.
   d. Temporary protection requirements for metal roof panel assembly during and after installation.
   e. Roof observation and repair after metal roof panel installation.

3. Review methods and procedures related to metal wall panel assemblies including, but not limited to, the following:
   a. Compliance with requirements for support conditions, including alignment between and attachment to structural members.
   b. Structural limitations of girts and columns during and after wall panel installation.
   c. Flashings, special siding details, wall penetrations, openings, and condition of other construction that will affect metal wall panels.
   d. Temporary protection requirements for metal wall panel assembly during and after installation.
   e. Wall observation and repair after metal wall panel installation.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of metal building system component.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for the following:
   a. Metal roof panels.
   b. Metal wall panels.
   c. Metal soffit panels.
   d. Thermal insulation and air barrier facings.

B. Shop Drawings: Indicate components by others. Include full building plan, elevations, sections, details and the following:

1. Anchor-Rod Plans: Submit anchor-rod plans and templates before foundation work begins. Include location, diameter, and minimum required projection of anchor rods required to attach metal building to foundation. Indicate column reactions at each location.
2. Structural-Framing Drawings: Show complete fabrication of primary and secondary framing; include provisions for openings. Indicate welds and bolted connections, distinguishing between shop and field applications. Include transverse cross-sections.
3. Metal Roof and Wall Panel Layout Drawings: Show layouts of panels including methods of support. Include details of edge conditions, joints, panel profiles, corners, anchorages, clip spacing, trim, flashings, closures, and special details. Distinguish between factory- and field-assembled work; show locations of exposed fasteners.
   a. Show roof-mounted items and penetrations.
   b. Show wall-mounted items including personnel doors, vehicular doors, windows, louvers, and lighting fixtures.

4. Accessory Drawings: Include details of the following items, at a scale of not less than 1-1/2 inches per 12 inches:
   a. Flashing and trim.
   b. Gutters.
   c. Downspouts.

C. Samples for Verification: For the following products:

1. Panels: Nominal 12 inches long by actual panel width. Include fasteners, closures, and other exposed panel accessories.
2. Flashing and Trim: Nominal 12 inches long. Include fasteners and other exposed accessories.
3. Vapor Retarder Facings: Nominal 6-inch- square Samples.
4. Accessories: Nominal 12-inch- long Samples for each type of accessory.

D. Delegated-Design Submittal: For metal building systems.

1. Include analysis data indicating compliance with performance requirements and design data signed and sealed by the qualified professional engineer responsible for their preparation.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For manufacturer and erector.

B. Welding certificates.

C. Letter of Design Certification: Signed and sealed by a qualified professional engineer. Include the following:

1. Name and location of Project.
2. Order number.
3. Name of manufacturer.
4. Name of Contractor.
5. Building dimensions including width, length, height, and roof slope.
6. Indicate compliance with AISC standards for hot-rolled steel and AISI standards for cold-rolled steel, including edition dates of each standard.
7. Governing building code and year of edition.
8. Design Loads: Include dead load, roof live load, collateral loads, deflection, wind loads/speeds and exposure, seismic design category, and auxiliary loads (cranes).
9. Load Combinations: Indicate that loads were applied acting simultaneously with concentrated loads, according to governing building code.
10. Building-Use Category: Indicate category of building use and its effect on load importance factors.

D. Erector Certificates: For qualified erector, from manufacturer.

E. Material Test Reports: For each of the following products:

1. Structural steel including chemical and physical properties.
2. Bolts, nuts, and washers including mechanical properties and chemical analysis.
3. Tension-control, high-strength, bolt-nut-washer assemblies.
4. Shop primers.
5. Nonshrink grout.

F. Source quality-control reports.

G. Field quality-control reports.

H. Surveys: Show final elevations and locations of major members. Indicate discrepancies between actual installation and the Contract Documents. Have surveyor who performed surveys certify their accuracy.

I. Sample Warranties: For special warranties.

1.7 CLOSEOUT SUBMITTALS

A. Maintenance Data: For metal panel finishes to include in maintenance manuals.

1.8 QUALITY ASSURANCE

A. Manufacturer Qualifications: A qualified manufacturer.

1. Accreditation: Manufacturer's facility accredited according to the International Accreditation Service's AC472, "Accreditation Criteria for Inspection Programs for Manufacturers of Metal Building Systems."
2. Engineering Responsibility: Preparation of comprehensive engineering analysis and Shop Drawings by a professional engineer who is legally qualified to practice in jurisdiction where Project is located.

B. Erector Qualifications: An experienced erector who specializes in erecting and installing work similar in material, design, and extent to that indicated for this Project and who is acceptable to manufacturer.

C. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
2. AWS D1.3, "Structural Welding Code - Sheet Steel."

D. Land Surveyor Qualifications: A professional land surveyor who practices in jurisdiction where Project is located and who is experienced in providing surveying services of the kind indicated.

E. Mockups: Build integrated exterior mockup in accordance with Section 014000 "Quality Requirements" to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.

1. Build mockup of typical wall area as shown on Drawings.
2. Mockup shall include all types of metal wall panels, including accessories.
   a. Size: Minimum 8 x 8 feet.
   b. Include curtain wall framing with glazing, minimum 12 inches wide by 16 inches high.
   c. Include flashing and trim around window and at wall bottom.
   d. Include metal studs, sheathing, sheathing joint-and-penetration treatment, air barrier, flashing, trim, and sealant.
3. Approval of mockup does not constitute approval of deviations from the Contract Documents contained in mockup unless Architect specifically approves such deviations in writing.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Deliver components, sheets, panels, and other manufactured items so as not to be damaged or deformed. Package metal panels for protection during transportation and handling.

B. Unload, store, and erect metal panels in a manner to prevent bending, warping, twisting, and surface damage.

C. Stack metal panels horizontally on platforms or pallets, covered with suitable weathertight and ventilated covering. Store metal panels to ensure dryness, with positive slope for drainage of water. Do not store metal panels in contact with other materials that might cause staining, denting, or other surface damage.

1.10 FIELD CONDITIONS

A. Weather Limitations: Proceed with panel installation only when weather conditions permit metal panels to be installed according to manufacturers' written instructions and warranty requirements.

1.11 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal wall and roof panel assemblies that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:
   a. Structural failures including rupturing, cracking, or puncturing.
   b. Deterioration of metals and other materials beyond normal weathering.

2. Warranty Period: Two years from date of Substantial Completion.

B. Special Warranty on Metal Panel Finishes: Manufacturer agrees to repair finish or replace metal panels that show evidence of deterioration of factory-applied finishes within specified warranty period.

1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:
   a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
   b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
   c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

2. Finish Warranty Period: 20 years from date of Substantial Completion.

C. Special Weathertightness Warranty for Metal Roof Panels: Manufacturer agrees to repair or replace standing seam metal roof panel assemblies that leak or otherwise fail to remain weathertight within specified warranty period.

1. Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design Manufacturer: Subject to compliance with requirements, provide pre-engineered metal buildings as manufactured by Rigid Global Buildings; www.rigidbuilding.com, or comparable products by one of the following:

1. Alliance Steel, Inc.
2. American Steel Building, Inc.
3. Butler Manufacturing Company.
4. NCI Building Systems LP.
5. Robert S. Henry Company.
6. United Structures of America.

B. Source Limitations:

1. Obtain metal building framing components, including primary and secondary framing, from single source from single manufacturer.
2. Obtain metal roof and wall panel assemblies from single source from single manufacturer.

2.2 SYSTEM DESCRIPTION

A. Provide a complete, integrated set of mutually dependent components and assemblies that form a metal building system capable of withstanding structural and other loads, thermally induced movement, and exposure to weather without failure or infiltration of water into building interior.

B. Primary-Frame Type:

1. Rigid Modular: Solid-member, structural-framing system with interior columns.

C. End-Wall Framing: Manufacturer's standard, for buildings not required to be expandable.

D. Secondary-Frame Type: Manufacturer's standard purlins and joists and partially inset-framed girts.

E. Eave Height: As indicated.

F. Bay Spacing: As indicated.

G. Roof Slope: As indicated.

H. Roof System: Standing-seam, vertical-rib metal roof panels over open framing.

I. Exterior Wall System: Metal wall panels, exposed fasteners.

1. Liner Panels: Flush profile.

2.3 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design metal building system.

B. Structural Performance: Metal building systems shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated according to procedures in MBMA's "Metal Building Systems Manual."

1. Design Loads: As indicated on Drawings.
2. Deflection and Drift Limits: No greater than the following:
   a. Purlins and Rafters: Vertical deflection of 1/180 of the span.
   b. Girts: Horizontal deflection of 1/360 of the span where bracing masonry and 1/180 where no masonry exists.
   c. Metal Roof Panels: Vertical deflection of 1/180 of the span.
   d. Metal Wall Panels: Horizontal deflection of 1/180 of the span.
   e. Design secondary-framing system to accommodate deflection of primary framing and construction tolerances, and to maintain clearances at openings.
   f. Lateral Drift: Maximum of l/360 of the building height where supporting masonry and l/180 where no masonry exists.

C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change: 120 deg F, ambient; 180 deg F material surfaces.

D. Structural Performance for Metal Roof and Wall Panels: Provide metal panel systems capable of withstanding the effects of the following loads, based on testing according to ASTM E 1592:

1. Wind Loads: As indicated on Drawings.

E. Air Infiltration for Metal Roof Panels: Air leakage of not more than 0.06 cfm/sq. ft. when tested according to ASTM E 1680 at the following test-pressure difference:

1. Test-Pressure Difference: 6.24 lbf/sq. ft.

F. Air Infiltration for Metal Wall Panels: Air leakage of not more than 0.06 cfm/sq. ft. when tested according to ASTM E 283 at the following test-pressure difference:

1. Test-Pressure Difference: 6.24 lbf/sq. ft.

G. Water Penetration for Metal Roof Panels: No water penetration when tested according to ASTM E 1646 at the following test-pressure difference:

1. Test-Pressure Difference: 12 lbf/sq. ft.

H. Water Penetration for Metal Wall Panels: No water penetration when tested according to ASTM E 331 at the following test-pressure difference:

1. Test-Pressure Difference: 12 lbf/sq. ft.

I. Wind-Uplift Resistance: Provide metal roof panel assemblies that comply with UL 580 for wind-uplift-resistance class indicated.

1. Uplift Rating: UL 90.

J. Thermal Performance for Opaque Elements: Provide the following minimum R-values when tested according to ASTM C 1363 or ASTM C 518:

1. Roof: R-30, total.
2. Walls: R-20, total.

2.4 STRUCTURAL-STEEL FRAMING

A. Structural Steel: Comply with AISC 360, "Specification for Structural Steel Buildings."

B. Bolted Connections: Comply with RCSC's "Specification for Structural Joints Using High-Strength Bolts."

C. Cold-Formed Steel: Comply with AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members" for design requirements and allowable stresses.

D. Primary Framing: Manufacturer's standard primary-framing system, designed to withstand required loads and specified requirements. Primary framing includes transverse and lean-to frames; rafters, rake, and canopy beams; sidewall, intermediate, end-wall, and corner columns; and wind bracing.

1. General: Provide frames with attachment plates, bearing plates, and splice members. Factory drill for field-bolted assembly. Provide frame span and spacing indicated.
   a. Slight variations in span and spacing may be acceptable if necessary to comply with manufacturer's standard, as approved by Architect.

2. Rigid Modular Frames: I-shaped frame sections fabricated from shop-welded, built-up steel plates or structural-steel shapes. Provide interior columns fabricated from round steel pipes or tubes, or shop-welded, built-up steel plates.
3. Frame Configuration: Multiple gable.
4. Exterior Columns: Tapered.
5. Rafters: Tapered.
6. Special Requirements: Configure framing to accommodate the following, as indicated on Drawings:
   a. Column-mounted bridge crane support.

E. End-Wall Framing: Manufacturer's standard primary end-wall framing fabricated for field-bolted assembly to comply with the following:

1. End-Wall and Corner Columns: I-shaped sections fabricated from structural-steel shapes; shop-welded, built-up steel plates; or C-shaped, cold-formed, structural-steel sheet.
2. End-Wall Rafters: C-shaped, cold-formed, structural-steel sheet; or I-shaped sections fabricated from shop-welded, built-up steel plates or structural-steel shapes.

F. Secondary Framing: Manufacturer's standard secondary framing, including purlins, girts, eave struts, flange bracing, base members, gable angles, clips, headers, jambs, and other miscellaneous structural members. Unless otherwise indicated, fabricate framing from either cold-formed, structural-steel sheet or roll-formed, metallic-coated steel sheet, prepainted with coil coating, to comply with the following:

1. Purlins: C- or Z-shaped sections; fabricated from built-up steel plates, steel sheet, or structural-steel shapes; minimum 2-1/2-inch- wide flanges.
   a. Depth: 8 inch.

2. Girts: C- or Z-shaped sections; fabricated from built-up steel plates, steel sheet, or structural-steel shapes. Form ends of Z-sections with stiffening lips angled 40 to 50 degrees from flange, with minimum 2-1/2-inch- wide flanges.
   a. Depth: 8 inch and 10 inch, as indicated.

3. Eave Struts: Unequal-flange, C-shaped sections; fabricated from built-up steel plates, steel sheet, or structural-steel shapes; to provide adequate backup for metal panels.

4. Flange Bracing: Minimum 2-by-2-by-1/8-inch structural-steel angles or 1-inch diameter, cold-formed structural tubing to stiffen primary-frame flanges.
5. Sag Bracing: Minimum 1-by-1-by-1/8-inch structural-steel angles.
6. Base or Sill Channels: Manufacturer's standard base channel, fabricated from zinc-coated (galvanized) steel sheet.
7. Purlin and Girt Clips: Manufacturer's standard clips fabricated from steel sheet. Provide galvanized clips where clips are connected to galvanized framing members.
8. Framing for Openings: Channel shapes; fabricated from cold-formed, structural-steel sheet or structural-steel shapes. Frame head and jamb of door openings and head, jamb, and sill of other openings.
9. Miscellaneous Structural Members: Manufacturer's standard sections fabricated from cold-formed, structural-steel sheet; built-up steel plates; or zinc-coated (galvanized) steel sheet; designed to withstand required loads.

G. Bracing: Rods, angles, or rigid portal frames as indicated.

1. Rods: ASTM A36/A36M; ASTM A572/A572M, Grade 50; or ASTM A529/A529M, Grade 50; minimum 1/2-inch- diameter steel; threaded full length or threaded a minimum of 6 inches at each end.
2. Angles: Fabricated from structural-steel shapes to match primary framing, of size required to withstand design loads.
3. Rigid Portal Frames: Fabricated from shop-welded, built-up steel plates or structural-steel shapes to match primary framing; of size required to withstand design loads.

H. Anchor Rods: Headed anchor rods as indicated in Anchor Rod Plan for attachment of metal building to foundation.

I. Materials:

1. W-Shapes: ASTM A992/A992M; ASTM A572/A572M, Grade 50 or 55; or ASTM A529/A529M, Grade 50 or 55
2. Channels, Angles, M-Shapes, and S-Shapes: ASTM A36/A36M; ASTM A572/A572M, Grade 50 or 55; or ASTM A529/A529M, Grade 50 or 55.
3. Plate and Bar: ASTM A36/A36M; ASTM A572/A572M, Grade 50 or 55; or ASTM A529/A529M, Grade 50 or 55.
4. Steel Pipe: ASTM A53/A53M, Type E or S, Grade B.
5. Cold-Formed Hollow Structural Sections: ASTM A500, Grade B or C, structural tubing.
6. Structural-Steel Sheet: Hot-rolled, ASTM A1011/A1011M, Structural Steel (SS), Grades 30 through 55, or High-Strength Low-Alloy Steel (HSLAS) or High-Strength Low-Alloy Steel with Improved Formability (HSLAS-F), Grades 45 through 70; or cold-rolled, ASTM A1008/A1008M, Structural Steel (SS), Grades 25 through 80, or HSLAS, Grades 45 through 70.
7. Metallic-Coated Steel Sheet: ASTM A653/A653M, SS, Grades 33 through 80, or HSLAS or HSLAS-F, Grades 50 through 80; with G60coating designation; mill phosphatized.
8. Metallic-Coated Steel Sheet Prepainted with Coil Coating: Steel sheet, metallic coated by the hot-dip process and prepainted by the coil-coating process to comply with ASTM A755/A755M.
   a. Zinc-Coated (Galvanized) Steel Sheet: ASTM A653/A653M, SS, Grades 33 through 80, or HSLAS or HSLAS-F, Grades 50 through 80; with G90coating designation.
   b. Aluminum-Zinc Alloy-Coated Steel Sheet: ASTM A792/A792M, SS, Grade 50 or 80; with Class AZ50coating.

9. Non-High-Strength Bolts, Nuts, and Washers: ASTM A307, Grade A, carbon-steel, hex-head bolts; ASTM A563 carbon-steel hex nuts; and ASTM F844 plain (flat) steel washers.

a. Finish: Plain, or either hot-dip zinc coating, ASTM F2329 Class C, or mechanically deposited zinc coating, ASTM B695 Class 50, where indicated.

10. High-Strength Bolts, Nuts, and Washers: ASTM F3125/F3125M,Grade A325, Type 1, heavy-hex steel structural bolts; ASTM A563, Grade DH, heavy-hex carbon-steel nuts; and ASTM F436/F436M, Type 1, hardened carbon-steel washers.
    a. Finish: Plain, or either hot-dip zinc coating, ASTM F2329 Class C, or mechanically deposited zinc coating, ASTM B695 Class 50, where indicated.

11. Tension-Control, High-Strength Bolt-Nut-Washer Assemblies: ASTM F3125/F3125M, Grade F1852, Type 1, heavy-hex head assemblies consisting of steel structural bolts with splined ends; ASTM A563, Grade DH, heavy-hex carbon-steel nuts; and ASTM F436/F436M, Type 1 hardened carbon-steel washers.
    a. Finish: Plain, or mechanically deposited zinc coating, ASTM B695 Class 50, where indicated.

12. Unheaded Anchor Rods: ASTM F1554, Grade 36.
    a. Configuration: Straight.
    b. Nuts: ASTM A563 heavy-hex carbon steel.
    c. Plate Washers: ASTM A36/A36M carbon steel.
    d. Washers: ASTM F436 hardened carbon steel.
    e. Finish: Plain, or hot-dip galvanized, ASTM A 153, Class C where indicated.

13. Threaded Rods: ASTM A193/A193M.
    a. Nuts: ASTM A563 heavy-hex carbon steel.
    b. Washers: ASTM F436 hardened carbon steel.
    c. Finish: Plain, or either hot-dip zinc coating, ASTM F2329 Class C, or mechanically deposited zinc coating, ASTM B695 Class 50, where indicated.

J. Finish: Factory primed. Apply specified primer immediately after cleaning and pretreating.

1. Clean and prepare in accordance with SSPC-SP2.
2. Coat with manufacturer's standard primer. Apply primer to primary and secondary framing to a minimum dry film thickness of 1 mil.
    a. Prime secondary framing formed from uncoated steel sheet to a minimum dry film thickness of 0.5 milon each side.

2.5 METAL ROOF PANELS

A. Standing-Seam, Vertical-Rib, Metal Roof Panels: Formed with vertical ribs at panel edges and flat pan between ribs; designed for non-sequential installation by mechanically attaching panels to supports using concealed clips located under one side of panels and engaging opposite edge of adjacent panels.

1. Material: Zinc-coated (galvanized) or aluminum-zinc alloy-coated steel sheet, 0.030-inch nominal uncoated steel thickness. Prepainted by the coil-coating process to comply with ASTM A 755/A 755M.
    a. Exterior Finish: Mica fluoropolymer.
    b. Color: As indicated.

2. Clips: Two-piece floating to accommodate thermal movement.
3. Joint Type: Double seamed.
4. Panel Coverage: 16 inches
5. Panel Height: 2 inches
6. Panel Design: Flat, with intermediate stiffening ribs.
7. Basis-of-Design: Platinum Series as manufactured by Rigid Global Buildings.

B. Finishes:

1. Exposed Coil-Coated Finish:
   a. Mica Fluoropolymer: AAMA 621. Two-coat fluoropolymer finish with suspended mica flakes containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

2. Concealed Finish: Apply pretreatment and manufacturer's standard white or light-colored acrylic or polyester backer finish, consisting of prime coat and wash coat with a minimum total dry film thickness of 0.5 mil.

2.6 METAL WALL PANELS

A. Exposed Fastener, Tapered-Rib, Metal Wall Panels: Formed with raised trapezoidal major ribs and flat pan between major ribs, designed to be installed by lapping side edges of adjacent panels and mechanically attaching panels to supports using exposed fasteners in side laps.

1. Material: Zinc-coated (galvanized) or aluminum-zinc alloy-coated steel sheet, 0.030-inch (22 gage) nominal uncoated steel thickness. Prepainted by the coil-coating process to comply with ASTM A 755/A 755M.
   a. Exterior Finish: Mica fluoropolymer.
   b. Color: As selected by Architect from manufacturer's full range.

2. Panel Coverage: 36 inches
3. Panel Height: 3/4 inches
4. Configuration: As indicated.
5. Basis-of-Design: Reversed "M" Wall Panel as manufactured by Rigid Global Buildings.

B. Finishes:

1. Exposed Coil-Coated Finish:
   a. Mica Fluoropolymer: AAMA 621. Two-coat fluoropolymer finish with suspended mica flakes containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

2. Concealed Finish: Apply pretreatment and manufacturer's standard white or light-colored acrylic or polyester backer finish, consisting of prime coat and wash coat with a minimum total dry film thickness of 0.5 mil.

2.7 THERMAL INSULATION

A. Faced Metal Building Insulation: ASTM C 991, Type II, glass-fiber-blanket insulation; 0.5-lb/cu. ft. density; 2-inch- wide, continuous, air and vapor-tight edge tabs; with a flame-spread index of 25 or less.

B. Retainer Strips: For securing insulation between supports, 0.025-inch nominal-thickness, formed, metallic-coated steel or PVC retainer clips colored to match insulation facing.

C. Air- and Vapor-Retarder Facing: ASTM C 1136, with permeance not greater than 0.02 perm when tested according to ASTM E 96/E 96M, Desiccant Method.

1. Composition: White metallized-polypropylene film facing, fiberglass scrim reinforcement, and kraft-paper backing.
2. Provide perforated facings where facings are exposed to building interior.
3. Basis-of-Design: WMP-30, manufactured by Lamtec Corporation; www.lamtec.com.

D. Vapor-Retarder Tape: Pressure-sensitive tape of type recommended by vapor-retarder manufacturer for sealing joints and penetrations in vapor retarder.

2.8 ACCESSORIES

A. General: Provide accessories as standard with metal building system manufacturer and as specified. Fabricate and finish accessories at the factory to greatest extent possible, by manufacturer's standard procedures and processes. Comply with indicated profiles and with dimensional and structural requirements.

1. Form exposed sheet metal accessories that are without excessive oil-canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.

B. Roof Panel Accessories: Provide components required for a complete metal roof panel assembly including copings, fasciae, corner units, ridge closures, clips, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal roof panels unless otherwise indicated.

1. Closures: Provide closures at eaves and ridges, fabricated of same material as metal roof panels.
2. Clips: Manufacturer's standard, formed from stainless-steel sheet, designed to withstand negative-load requirements.
3. Cleats: Manufacturer's standard, mechanically seamed cleats formed from prefinished steel sheet.
4. Backing Plates: Provide metal backing plates at panel end splices, fabricated from material recommended by manufacturer.
5. Thermal Spacer Blocks: Where metal panels attach directly to purlins, provide thermal spacer blocks of thickness required to provide 1-inch standoff; fabricated from extruded polystyrene with prefinished steel facers.
   a. Basis-of-Design: Sealed N Safe, SNS Thermal Block; www.sealednsafe.com.

C. Wall Panel Accessories: Provide components required for a complete metal wall panel assembly including copings, fasciae, sills, corner units, clips, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal wall panels unless otherwise indicated.

1. Closures: Provide closures at eaves and rakes, fabricated of same material as metal wall panels.
2. Backing Plates: Provide metal backing plates at panel end splices, fabricated from material recommended by manufacturer.
3. Closure Strips: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell laminated polyethylene; minimum 1-inch- thick, flexible closure strips; cut or premolded to match metal wall panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction.
4. Thermal Spacer Blocks: Where metal panels attach directly to girts, provide thermal spacer blocks of thickness required to provide 1-inch standoff; fabricated from extruded polystyrene with prefinished steel facers.
   a. Basis-of-Design: Sealed N Safe, SNS Thermal Block; www.sealednsafe.com.

D. Flashing and Trim: Zinc-coated (galvanized) or aluminum-zinc alloy-coated steel sheet, 0.024-inch nominal uncoated steel thickness, prepainted with coil coating; finished to match adjacent metal panels.

1. Provide flashing and trim as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, eaves, rakes, corners, bases, framed openings, ridges, fasciae, and fillers.
2. Opening Trim: Zinc-coated (galvanized) or aluminum-zinc alloy-coated steel sheet, 0.024-inch (24 gage) nominal uncoated steel thickness, prepainted with coil coating. Trim head and jamb of door openings, and head, jamb, and sill of other openings.

E. Gutters: Zinc-coated (galvanized) or aluminum-zinc alloy-coated steel sheet, 0.024-inch (24 gage) nominal uncoated steel thickness, prepainted with coil coating. Match profile of gable trim, complete with end pieces, outlet tubes, and other special pieces as required. Fabricate in minimum 96-inch- long sections, sized according to SMACNA's "Architectural Sheet Metal Manual."

1. Gutter Supports: Fabricated from same material and finish as gutters.
2. Finish: Two coat fluoropolymer, color as indicated.

F. Downspouts: Zinc-coated (galvanized) or aluminum-zinc alloy-coated steel sheet, 0.024-inch nominal uncoated steel thickness, prepainted with coil coating. Fabricate in minimum 10-foot-long sections, complete with formed elbows and offsets.

1. Mounting Straps: Fabricated from same material and finish as gutters.
2. Finish: Two coat fluoropolymer, color as indicated.

G. Roof Curbs: Zinc-coated (galvanized) or aluminum-zinc alloy-coated steel sheet, 0.048-inch nominal uncoated steel thickness prepainted with coil coating; finished to match metal roof panels; with welded top box and bottom skirt, and integral full-length cricket; capable of withstanding loads of size and height indicated.

1. Curb Subframing: Zinc-coated (galvanized) or aluminum-zinc alloy-coated steel sheet, 0.060-inch (16 gage) nominal uncoated steel thickness, angle-, C-, or Z-shaped metallic-coated steel sheet.
2. Insulation: 1-inch- thick, rigid type.

H. Pipe Flashing: Premolded, EPDM pipe collar with flexible aluminum ring bonded to base.

I. Materials:

1. Fasteners: Self-tapping screws, bolts, nuts, self-locking rivets and bolts, end-welded studs, and other suitable fasteners designed to withstand design loads. Provide fasteners with heads matching color of materials being fastened by means of plastic caps or factory-applied coating.
   a. Fasteners for Metal Wall and Roof Panels: Self-drilling or self-tapping hex-head screws, stainless steel or zinc-plated carbon-steel, with EPDM sealing washer.
   b. Fasteners for Flashing and Trim: Blind fasteners or self-drilling screws with hex washer head.
   c. Blind Fasteners: High-strength aluminum or stainless-steel rivets.
2. Corrosion-Resistant Coating: Cold-applied asphalt mastic, compounded for 15-mil dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.
3. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107/C 1107M, factory-packaged, nonmetallic aggregate grout, noncorrosive, nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.
4. Metal Panel Sealants:

a. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene-compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape of manufacturer's standard size.
b. Joint Sealant: ASTM C 920; one part elastomeric polyurethane or polysulfide; of type, grade, class, and use classifications required to seal joints in metal panels and remain weathertight; and as recommended by metal building system manufacturer.

2.9 FABRICATION

A. General: Design components and field connections required for erection to permit easy assembly.

1. Mark each piece and part of the assembly to correspond with previously prepared erection drawings, diagrams, and instruction manuals.
2. Fabricate structural framing to produce clean, smooth cuts and bends. Punch holes of proper size, shape, and location. Members shall be free of cracks, tears, and ruptures.

B. Tolerances: Comply with MBMA's "Metal Building Systems Manual" for fabrication and erection tolerances. In addition, comply with CMMA Specification No. 70 "Specifications for Electrical Overhead Traveling Cranes," and CMMA Specification No. 74 "Specification for Top Running and Under Running Single Girder Electric Overhead Traveling Cranes" for crane rail installation tolerances.

C. Primary Framing: Shop fabricate framing components to indicated size and section, with baseplates, bearing plates, stiffeners, and other items required for erection welded into place. Cut, form, punch, drill, and weld framing for bolted field assembly.

1. Make shop connections by welding or by using high-strength bolts.
2. Join flanges to webs of built-up members by a continuous, submerged arc-welding process.
3. Brace compression flange of primary framing with steel angles or cold-formed structural tubing between frame web and purlin web or girt web, so flange compressive strength is within allowable limits for any combination of loadings.
4. Weld clips to frames for attaching secondary framing if applicable, or punch for bolts.
5. Shop Priming: Prepare surfaces for shop priming according to SSPC-SP 2. Shop prime primary framing with specified primer after fabrication.

D. Secondary Framing: Shop fabricate framing components to indicated size and section by roll forming or break forming, with baseplates, bearing plates, stiffeners, and other plates required for erection welded into place. Cut, form, punch, drill, and weld secondary framing for bolted field connections to primary framing.

1. Make shop connections by welding or by using non-high-strength bolts.
2. Shop Priming: Prepare uncoated surfaces for shop priming according to SSPC-SP 2. Shop prime uncoated secondary framing with specified primer after fabrication.

E. Metal Panels: Fabricate and finish metal panels at the factory to greatest extent possible, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements. Comply with indicated profiles and with dimensional and structural requirements.

1. Provide panel profile, including major ribs and intermediate stiffening ribs, if any, for full length of metal panel.

2.10 SOURCE QUALITY CONTROL

A. Special Inspection: Owner will engage a qualified special inspector to perform source quality control inspections and to submit reports.

1. Accredited Manufacturers: Special inspections will not be required if fabrication is performed by an IAS AC472-accredited manufacturer approved by authorities having jurisdiction to perform such Work without special inspection.
   a. After fabrication, submit copy of certificate of compliance to authorities having jurisdiction, certifying that Work was performed according to Contract requirements.

PART 3 - EXECUTION

3.1 EXAMINATION

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

B. Before erection proceeds, survey elevations and locations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments to receive structural framing, with erector present, for compliance with requirements and metal building system manufacturer's tolerances.

C. Proceed with erection only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean and prepare surfaces to be painted according to manufacturer's written instructions for each particular substrate condition.

B. Provide temporary shores, guys, braces, and other supports during erection to keep structural framing secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural framing, connections, and bracing are in place unless otherwise indicated.

3.3 ERECTION OF STRUCTURAL FRAMING

A. Erect metal building system according to manufacturer's written instructions and drawings.

B. Do not field cut, drill, or alter structural members without written approval from metal building system manufacturer's professional engineer.

C. Set structural framing accurately in locations and to elevations indicated, according to AISC specifications referenced in this Section. Maintain structural stability of frame during erection.

D. Base and Bearing Plates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting plates. Clean bottom surface of plates.

1. Set plates for structural members on wedges, shims, or setting nuts as required.

2. Tighten anchor rods after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of plate before packing with grout.
3. Promptly pack grout solidly between bearing surfaces and plates so no voids remain. Neatly finish exposed surfaces; protect grout and allow to cure. Comply with manufacturer's written installation instructions for shrinkage-resistant grouts.

E. Align and adjust structural framing before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that will be in permanent contact with framing. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.

1. Level and plumb individual members of structure.
2. Make allowances for difference between temperature at time of erection and mean temperature when structure will be completed and in service.

F. Primary Framing and End Walls: Erect framing level, plumb, rigid, secure, and true to line. Level baseplates to a true even plane with full bearing to supporting structures, set with double-nutted anchor bolts. Use grout to obtain uniform bearing and to maintain a level base-line elevation. Moist-cure grout for not less than seven days after placement.

1. Make field connections using high-strength bolts installed according to RCSC's "Specification for Structural Joints Using High-Strength Bolts" for bolt type and joint type specified.
   a. Joint Type: Snug tightened or pretensioned as required by manufacturer.

G. Secondary Framing: Erect framing level, plumb, rigid, secure, and true to line. Field bolt secondary framing to clips attached to primary framing.

1. Provide rake or gable purlins with tight-fitting closure channels and fasciae.
2. Locate and space wall girts to suit openings such as doors and windows.
3. Provide supplemental framing at entire perimeter of openings, including doors, windows, louvers, ventilators, and other penetrations of roof and walls.

H. Bracing: Install bracing in roof and sidewalls where indicated on erection drawings.

1. Tighten rod and cable bracing to avoid sag.
2. Locate interior end-bay bracing only where indicated.

I. Framing for Openings: Provide shapes of proper design and size to reinforce openings and to carry loads and vibrations imposed, including equipment furnished under mechanical and electrical work. Securely attach to structural framing.

J. Erection Tolerances: Maintain erection tolerances of structural framing within AISC 303.

3.4 METAL PANEL INSTALLATION, GENERAL

A. Fabricate and finish metal panels and accessories at the factory, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.

B. On-Site Fabrication: Subject to compliance with requirements of this Section, metal panels may be fabricated on-site using UL-certified, portable roll-forming equipment if panels are of same profile and warranted by manufacturer to be equal to factory-formed panels. Fabricate according to equipment manufacturer's written instructions and to comply with details shown.

C. Examination: Examine primary and secondary framing to verify that structural-panel support members and anchorages have been installed within alignment tolerances required by manufacturer.

1. Examine roughing-in for components and systems penetrating metal panels, to verify actual locations of penetrations relative to seams before metal panel installation.

D. General: Anchor metal panels and other components of the Work securely in place, with provisions for thermal and structural movement.

1. Field cut metal panels as required for doors, windows, and other openings. Cut openings as small as possible, neatly to size required, and without damage to adjacent metal panel finishes.
   a. Field cutting of metal panels by torch is not permitted unless approved in writing by manufacturer.
2. Install metal panels perpendicular to structural supports unless otherwise indicated.
3. Flash and seal metal panels with weather closures at perimeter of openings and similar elements. Fasten with self-tapping screws.
4. Locate and space fastenings in uniform vertical and horizontal alignment.
5. Locate metal panel splices over structural supports with end laps in alignment.
6. Lap metal flashing over metal panels to allow moisture to run over and off the material.

E. Lap-Seam Metal Panels: Install screw fasteners using power tools with controlled torque adjusted to compress EPDM washers tightly without damage to washers, screw threads, or metal panels. Install screws in predrilled holes.

F. Metal Protection: Where dissimilar metals contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with corrosion-resistant coating, by applying rubberized-asphalt underlayment to each contact surface, or by other permanent separation as recommended by metal roof panel manufacturer.

G. Joint Sealers: Install gaskets, joint fillers, and sealants where indicated and where required for weatherproof performance of metal panel assemblies. Provide types of gaskets, fillers, and sealants indicated; or, if not indicated, provide types recommended by metal panel manufacturer.

1. Seal metal panel end laps with double beads of tape or sealant the full width of panel. Seal side joints where recommended by metal panel manufacturer.
2. Prepare joints and apply sealants to comply with requirements in Section 079200 "Joint Sealants."

3.5 METAL ROOF PANEL INSTALLATION

A. General: Provide metal roof panels of full length from eave to ridge unless otherwise indicated or restricted by shipping limitations.

1. Install ridge caps as metal roof panel work proceeds.
2. Flash and seal metal roof panels with weather closures at eaves and rakes. Fasten with self-tapping screws.

B. Standing-Seam Metal Roof Panels: Fasten metal roof panels to supports with concealed clips at each standing-seam joint, at location and spacing and with fasteners recommended by manufacturer.

1. Install clips to supports with self-drilling or self-tapping fasteners.

2. Install pressure plates at locations indicated in manufacturer's written installation instructions.
3. Seamed Joint: Crimp standing seams with manufacturer-approved motorized seamer tool so that clip, metal roof panel, and factory-applied sealant are completely engaged.
4. Rigidly fasten eave end of metal roof panels and allow ridge end free movement for thermal expansion and contraction. Predrill panels for fasteners.
5. Provide metal closures at peaks, rake edges, rake walls, and each side of ridge and hip caps.

C. Metal Fascia Panels: Align bottom of metal panels and fasten with blind rivets, bolts, or self-drilling or self-tapping screws. Flash and seal metal panels with weather closures where fasciae meet soffits, along lower panel edges, and at perimeter of all openings.

D. Metal Roof Panel Installation Tolerances: Shim and align metal roof panels within installed tolerance of 1/4 inch in 20 feet on slope and location lines and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.

3.6 METAL WALL PANEL INSTALLATION

A. General: Install metal wall panels in orientation, sizes, and locations indicated on Drawings. Install panels perpendicular to framing members, extending full height of building, unless otherwise indicated. Anchor metal wall panels and other components of the Work securely in place, with provisions for thermal and structural movement.

1. Unless otherwise indicated, begin metal panel installation at corners with center of rib lined up with line of framing.
2. Shim or otherwise plumb substrates receiving metal wall panels.
3. When two rows of metal panels are required, lap panels 4 inches minimum.
4. When building height requires two rows of metal panels at gable ends, align lap of gable panels over metal wall panels at eave height.
5. Rigidly fasten base end of metal wall panels and allow eave end free movement for thermal expansion and contraction. Predrill panels.
6. Flash and seal metal wall panels with weather closures at eaves and rakes, and at perimeter of all openings. Fasten with self-tapping screws.
7. Install screw fasteners in predrilled holes.
8. Install flashing and trim as metal wall panel work proceeds.
9. Apply elastomeric sealant continuously between metal base channel (sill angle) and concrete, and elsewhere as indicated on Drawings; if not indicated, as necessary for waterproofing.
10. Align bottom of metal wall panels and fasten with blind rivets, bolts, or self-drilling or self-tapping screws.
11. Provide weatherproof escutcheons for pipe and conduit penetrating exterior walls.

B. Metal Wall Panels: Install metal wall panels on exterior side of girts. Attach metal wall panels to supports with fasteners as recommended by manufacturer.

C. Installation Tolerances: Shim and align metal wall panels within installed tolerance of 1/4 inch in 20 feet, noncumulative; level, plumb, and on location lines; and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.

3.7 THERMAL INSULATION INSTALLATION

A. General: Install insulation concurrently with metal panel installation, in thickness indicated to cover entire surface, according to manufacturer's written instructions.

1. Set vapor-retarder-faced units with vapor retarder toward outside of building. Do not obstruct ventilation spaces except for firestopping.
2. Tape joints and ruptures in vapor retarder, and seal each continuous area of insulation to the surrounding construction to ensure airtight installation.
3. Install factory-laminated, vapor-retarder-faced blankets straight and true in one-piece lengths, with both sets of facing tabs sealed, to provide a complete vapor retarder.

B. Blanket Roof Insulation: Comply with the following installation method:

1. Two-Layers-between-Purlin-with-Spacer-Block Installation: Extend insulation and vapor retarder between purlins. Carry vapor-retarder-facing tabs up and over purlin, overlapping adjoining facing of next insulation course and maintaining continuity of retarder. Install layer of filler insulation over first layer to fill space between purlins formed by thermal spacer blocks. Hold in place with bands and crossbands below insulation.
   a. Thermal Spacer Blocks: Where metal roof panels attach directly to purlins, install thermal spacer blocks.

2. Retainer Strips: Install retainer strips at each longitudinal insulation joint, straight and taut, nesting with secondary framing to hold insulation in place.

C. Blanket Wall Insulation: Extend insulation and vapor retarder over and perpendicular to top flange of secondary framing. Hold in place by metal wall panels fastened to secondary framing.

1. Retainer Strips: Install retainer strips at each longitudinal insulation joint, straight and taut, nesting with secondary framing to hold insulation in place.

3.8 ACCESSORY INSTALLATION

A. General: Install accessories with positive anchorage to building and weathertight mounting, and provide for thermal expansion. Coordinate installation with flashings and other components.

1. Install components for complete metal wall and roof panel assemblies, including trim, copings, corners, ridge closures, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items.
2. Where dissimilar metals contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with corrosion-resistant coating, by applying rubberized-asphalt underlayment to each contact surface, or by other permanent separation as recommended by manufacturer.

B. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.

1. Install exposed flashing and trim that is without excessive oil-canning, buckling, and tool marks and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and to result in waterproof and weather-resistant performance.
2. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet with no joints allowed within 24 inches of corner or intersection. Where lapped or bayonet-type expansion provisions cannot be used or would not be sufficiently weather resistant and waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with mastic sealant (concealed within joints).

C. Gutters: Join sections with riveted-and-soldered or lapped-and-sealed joints. Attach gutters to eave with gutter hangers spaced as required for gutter size, but not more than 36 inches o.c. using manufacturer's standard fasteners. Provide end closures and seal watertight with sealant. Provide for thermal expansion.

D. Downspouts: Join sections with 1-1/2-inch telescoping joints. Provide fasteners designed to hold downspouts securely 1 inch away from walls; locate fasteners at top and bottom and at approximately 60 inches o.c. in between.

1. Provide elbows at base of downspouts to direct water away from building.
2. Tie downspouts to underground drainage system indicated.

E. Pipe Flashing: Form flashing around pipe penetration and metal roof panels. Fasten and seal to panel as recommended by manufacturer.

3.9 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage a qualified special inspector to perform field quality control special inspections and to submit reports.

B. Product will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

3.10 CLEANING AND PROTECTION

A. Repair damaged galvanized coatings on galvanized items with galvanized repair paint according to ASTM A 780/A 780M and manufacturer's written instructions.

B. Touchup Painting: After erection, promptly clean, prepare, and prime or reprime field connections, rust spots, and abraded surfaces of prime-painted structural framing and accessories.

1. Clean and prepare surfaces by SSPC-SP 2, "Hand Tool Cleaning," or by SSPC-SP 3, "Power Tool Cleaning."
2. Apply a compatible primer of same type as shop primer used on adjacent surfaces.

C. Metal Panels: Remove temporary protective coverings and strippable films, if any, as metal panels are installed. On completion of metal panel installation, clean finished surfaces as recommended by metal panel manufacturer. Maintain in a clean condition during construction.

1. Replace metal panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 133419

SECTION 220513 - COMMON MOTOR REQUIREMENTS FOR PLUMBING EQUIPMENT

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 general requirements for single-phase, general-purpose, horizontal, small and medium, squirrel-cage induction motors for use on alternating-current power systems up to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.

1.3 COORDINATION

A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:

1. Motor controllers.
2. Torque, speed, and horsepower requirements of the load.
3. Ratings and characteristics of supply circuit and required control sequence.
4. Ambient and environmental conditions of installation location.

PART 2 - PRODUCTS

2.1 GENERAL MOTOR REQUIREMENTS

A. Comply with NEMA MG 1 unless otherwise indicated.

B. Comply with IEEE 841 for severe-duty motors.

2.2 MOTOR CHARACTERISTICS

A. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 3300 feet above sea level.

B. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

2.3 SINGLE-PHASE MOTORS

A. Motors larger than 1/20 hp shall be one of the following, to suit starting torque and requirements of specific motor application:

1. Permanent-split capacitor.
2. Split phase.
3. Capacitor start, inductor run.
4. Capacitor start, capacitor run.

B. Multispeed Motors: Variable-torque, permanent-split-capacitor type.

C. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.

D. Motors 1/20 HP and Smaller: Shaded-pole type.

E. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 220513

SECTION 220516 - EXPANSION FITTINGS AND LOOPS FOR PLUMBING PIPING

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. Rubber union connector packless expansion joints.
2. Flexible-hose packless expansion joints.
3. Metal-bellows packless expansion joints.
4. Externally pressurized metal-bellows packless expansion joints.
5. Rubber packless expansion joints.
6. Grooved-joint expansion joints.
7. Alignment guides and anchors.
8. Pipe loops and swing connections.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Delegated-Design Submittal: For each anchor and alignment guide, including analysis data, signed and sealed by the qualified professional engineer responsible for their preparation.

1. Design Calculations: Calculate requirements for thermal expansion of piping systems and for selecting and designing expansion joints, loops, and swing connections.
2. Anchor Details: Detail fabrication of each anchor indicated. Show dimensions and methods of assembly and attachment to building structure.
3. Alignment Guide Details: Detail field assembly and attachment to building structure.
4. Schedule: Indicate type, manufacturer's number, size, material, pressure rating, end connections, and location for each expansion joint.

1.4 INFORMATIONAL SUBMITTALS

A. Welding certificates.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For expansion joints to include in maintenance manuals.

1.6 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Pipe and Pressure-Vessel Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Compatibility: Products shall be suitable for piping service fluids, materials, working pressures, and temperatures.

B. Capability: Products to absorb 200 percent of maximum axial movement between anchors.

2.2 PACKLESS EXPANSION JOINTS

A. Rubber Union Connector Expansion Joints
   1. Material: Twin reinforced-rubber spheres with external restraining cables.
   2. Minimum Pressure Rating: 150 psig at 170 deg F, unless otherwise indicated.
   3. End Connections for NPS 2 and Smaller: Threaded.

B. Flexible-Hose Packless Expansion Joints FHEJ-01:

   1. Description: Manufactured assembly with inlet and outlet elbow fittings and two flexible-metal-hose legs joined by long-radius, 180-degree return bend or center section of flexible hose.
   2. Flexible Hose: Corrugated-metal inner hoses and braided outer sheaths.
   3. Expansion Joints for Copper Tubing NPS 2 and Smaller: Copper-alloy fittings with solder-joint end connections.
      a. Bronze hoses and single-braid bronze sheaths with 340 psig at 450 deg F ratings.
      b. Bronze hoses and double-braid bronze sheaths with 500 psig at 450 deg F ratings.
   4. Expansion Joints for Copper Tubing NPS 2-1/2 to NPS 4: Copper-alloy fittings with threaded end connections.
      a. Stainless-steel hoses and single-braid, stainless-steel sheaths with 225 psig at 450 deg F ratings.
      b. Stainless-steel hoses and double-braid, stainless-steel sheaths with 315 psig at 450 deg F ratings.
   5. Expansion Joints for Steel Piping NPS 2 and Smaller: Carbon-steel fittings with threaded end connections.
      a. Stainless-steel hoses and single-braid, stainless-steel sheaths with and 325 psig at 600 deg F ratings.
      b. Stainless-steel hoses and double-braid, stainless-steel sheaths with 515 psig at 600 deg F ratings.

6. Expansion Joints for Steel Piping NPS 2-1/2 to NPS 6: Carbon-steel fittings with flanged or welded end connections.

    a. Stainless-steel hoses and single-braid, stainless-steel sheaths with 200 psig at 70 deg F ratings.
    b. Stainless-steel hoses and double-braid, stainless-steel sheaths with 200 psig at 600 deg F ratings.

C. Metal-Bellows Packless Expansion Joints MBEJ-01:

1. Standards: ASTM F1120 and EJMA's "Standards of the Expansion Joint Manufacturers Association, Inc."
2. Type: Circular, corrugated bellows with external tie rods.
3. Minimum Pressure Rating: 150 psig unless otherwise indicated.
4. Configuration: Single joint or Single joint with base class(es), unless otherwise indicated.
5. Expansion Joints for Copper Tubing: Single or multi-ply phosphor-bronze bellows, copper pipe ends, and brass shrouds.

    a. End Connections for Copper Tubing NPS 2 and Smaller: Solder joint or threaded.
    b. End Connections for Copper Tubing NPS 2-1/2 to NPS 4: Solder joint or threaded.
    c. End Connections for Copper Tubing NPS 6 and Larger: Flanged.

6. Expansion Joints for Steel Piping: Single- or multi- ply stainless-steel bellows, steel pipe ends, and carbon-steel shroud.

    a. End Connections for Steel Pipe NPS 2 and Smaller: Threaded.
    b. End Connections for Steel Pipe NPS 2-1/2 and Larger: Flanged or Welded.

D. Externally Pressurized Metal-Bellows Packless Expansion Joints EPEJ-01:

1. Minimum Pressure Rating: 150 psig , unless otherwise indicated.
2. Description:

    a. Totally enclosed, externally pressurized, multi-ply, stainless-steel bellows isolated from fluid flow by an internal pipe sleeve.
    b. Carbon-steel housing.
    c. Drain plugs and lifting lug for NPS 3 and larger.
    d. Bellows shall have operating clearance between the internal pipe sleeves and the external shrouds.
    e. Joints shall be supplied with a built-in scale to confirm the starting position and operating movement.
    f. Joint Axial Movement: 4 inches of compression and 1 inch of extension.

3. Permanent Locking Bolts: Set locking bolts to maintain joint lengths during installation. Temporary welding tabs that are removed after installation in lieu of locking bolts are not acceptable.
4. End Connection Configuration: Flanged; one raised, fixed and one floating flange.

E. Rubber Packless Expansion Joints REJ-01:

1. Standards: ASTM F1123 and FSA's "Technical Handbook: Non-Metallic Expansion Joints and Flexible Pipe Connectors."
2. Material: Fabric-reinforced rubber complying with FSA-PSJ-703.
3. Arch Type: Single or multiple arches with external control rods.
4. Spherical Type: Single or multiple spheres with external control rods.
5. Minimum Pressure Rating for NPS 1-1/2 to NPS 4: 150 psig at 220 deg F .
6. Minimum Pressure Rating for NPS 6: 140 psig at 200 deg F .
7. Minimum Pressure Rating for NPS 8 to NPS 12: 140 psig at 180 deg F .

8. Material for Water: Butyl rubber, Buna-N, Chlorosulfonated polyethylene synthetic rubber, Chlorosulfonyl-polyethylene rubber, Ethylene-propylene-diene terpolymer rubber or Natural rubber.
9. End Connections: Full-faced, integral steel flanges with steel retaining rings.

2.3 GROOVED-JOINT EXPANSION JOINTS

A. Description: Factory-assembled expansion joint made of several grooved-end pipe nipples, couplings, and grooved joints.

B. Standard: AWWA C606, for grooved joints.

C. Nipples: Galvanized, ASTM A53/A53M, Schedule 40, Type E or S, steel pipe with grooved ends.

D. Couplings: Five flexible type for steel-pipe dimensions. Include ferrous housing sections, Buna-N gasket suitable for diluted acid, alkaline fluids, and cold and hot water or ethylene-propylene-diene terpolymer rubber gasket suitable for cold and hot water, and bolts and nuts.

2.4 ALIGNMENT GUIDES AND ANCHORS

A. Alignment Guides **AG-01** :

1. Description: Steel, factory-fabricated alignment guide, with bolted two-section outer cylinder and base for attaching to structure; with two-section guiding slider for bolting to pipe.

B. Anchor Materials:

1. Steel Shapes and Plates: ASTM A36/A36M.
2. Bolts and Nuts: ASME B18.10 or ASTM A183, steel hex head.
3. Washers: ASTM F844, steel, plain, flat washers.
4. Mechanical Fasteners: Insert-wedge-type stud with expansion plug anchor for use in hardened portland cement concrete, with tension and shear capacities appropriate for application.

    a. Stud: Threaded, zinc-coated carbon steel.
    b. Expansion Plug: Zinc-coated steel.
    c. Washer and Nut: Zinc-coated steel.

5. Chemical Fasteners: Insert-type stud, bonding-system anchor for use with hardened portland cement concrete, with tension and shear capacities appropriate for application.

    a. Bonding Material: ASTM C881/C881M, Type IV, Grade 3, two-component epoxy resin suitable for surface temperature of hardened concrete where fastener is to be installed.
    b. Stud: ASTM A307, zinc-coated carbon steel with continuous thread on stud, unless otherwise indicated.
    c. Washer and Nut: Zinc-coated steel.

PART 3 - EXECUTION

3.1 EXPANSION JOINT INSTALLATION

A. Install expansion joints of sizes matching sizes of piping in which they are installed.

B. Install metal-bellows expansion joints according to EJMA's "Standards of the Expansion Joint Manufacturers Association, Inc."

C. Install rubber packless expansion joints according to FSA-PSJ-703.

D. Install grooved-joint expansion joints to grooved-end steel piping.

3.2 PIPE LOOP AND SWING CONNECTION INSTALLATION

A. Install pipe loops cold-sprung in tension or compression as required to partly absorb tension or compression produced during anticipated change in temperature.

B. Connect risers and branch connections to mains with at least five pipe fittings, including tee in main.

C. Connect risers and branch connections to terminal units with at least four pipe fittings, including tee in riser.

D. Connect mains and branch connections to terminal units with at least four pipe fittings, including tee in main.

3.3 ALIGNMENT-GUIDE AND ANCHOR INSTALLATION

A. Install alignment guides to guide expansion and to avoid end-loading and torsional stress.

B. Install one guide on each side of pipe expansion fittings and loops. Install guides nearest to expansion joint not more than four pipe diameters from expansion joint.

C. Attach guides to pipe, and secure guides to building structure.

D. Install anchors at locations to prevent stresses from exceeding those permitted by ASME B31.9 and to prevent transfer of loading and stresses to connected equipment.

E. Anchor Attachments:

1. Anchor Attachment to Steel Pipe: Attach by welding. Comply with ASME B31.9 and ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
2. Anchor Attachment to Copper Tubing: Attach with pipe hangers. Use MSS SP-69, Type 24; U bolts bolted to anchor.

F. Fabricate and install steel anchors by welding steel shapes, plates, and bars. Comply with ASME B31.9 and AWS D1.1/D1.1M.

1. Anchor Attachment to Steel Structural Members: Attach by welding.

2. Anchor Attachment to Concrete Structural Members: Attach by fasteners. Follow fastener manufacturer's written instructions.

G. Use grout to form flat bearing surfaces for guides and anchors attached to concrete.

END OF SECTION 22016

SECTION 220517 - SLEEVES AND SLEEVE SEALS FOR PLUMBING PIPING

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. Sleeves.
2. Stack-sleeve fittings.
3. Sleeve-seal systems.
4. Sleeve-seal fittings.
5. Grout.
6. Silicone sealants.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.4 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

PART 2 - PRODUCTS

2.1 SLEEVES

A. Cast-Iron Pipe Sleeves: Cast or fabricated of cast or ductile iron and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop collar.

B. Steel Pipe Sleeves: ASTM A53/A53M, Type E, Grade B, Schedule 40, anticorrosion coated or galvanized, with plain ends and integral welded waterstop collar.

C. Galvanized-Steel Sheet Sleeves: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

D. PVC Pipe Sleeves: ASTM D1785, Schedule 40.

E. Molded-PVC Sleeves: With nailing flange for attaching to wooden forms.

F. Molded-PE or -PP Sleeves: Removable, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.

2.2 STACK-SLEEVE FITTINGS

A. Description: Manufactured, Dura-coated or Duco-coated galvanized cast-iron sleeve with integral clamping flange for use in waterproof floors and roofs. Include clamping ring, bolts, and nuts for membrane flashing.

1. Underdeck Clamp: Clamping ring with setscrews.

2.3 SLEEVE-SEAL SYSTEMS

A. Description:

1. Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.
2. Designed to form a hydrostatic seal of 20 psig minimum.
3. Sealing Elements: EPDM-rubber, High-temperature-silicone or Nitrile (Buna N) interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
4. Pressure Plates: Carbon steel, Stainless steel or Stainless steel, Type 316.
5. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, ASTM B633, Stainless steel or Stainless steel, Type 316 of length required to secure pressure plates to sealing elements.

2.4 SLEEVE-SEAL FITTINGS

A. Description: Manufactured plastic, sleeve-type, waterstop assembly made for imbedding in concrete slab or wall.

B. Plastic or rubber waterstop collar with center opening to match piping OD.

2.5 GROUT

A. Description: Nonshrink, for interior and exterior sealing openings in non-fire-rated walls or floors.

B. Standard: ASTM C1107/C1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.

C. Design Mix: 5000-psi, 28-day compressive strength.

D. Packaging: Premixed and factory packaged.

2.6 SILICONE SEALANTS

A. Silicone, S, NS, 25, NT: Single-component, nonsag, plus 25 percent and minus 25 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant, ASTM C920, Type S, Grade NS, Class 25, Use NT.

B. Silicone, S, P, 25, T, NT: Single-component, pourable, plus 25 percent and minus 25 percent movement capability, traffic- and nontraffic-use, neutral-curing silicone joint sealant; ASTM C920, Type S, Grade P, Class 25, Uses T and NT. Grade P Pourable (self-leveling) formulation is for opening in floors and other horizontal surfaces that are not fire rated.

C. Silicone Foam: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.

PART 3 - EXECUTION

3.1 SLEEVE INSTALLATION

A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.

B. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide 1-inch annular clear space between piping and concrete slabs and walls.

1. Sleeves are not required for core-drilled holes.

C. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.

1. Permanent sleeves are not required for holes in slabs formed by molded-PE or -PP sleeves.
2. 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.

3. Using grout or silicone sealant, seal the space outside of sleeves in slabs and walls without sleeve-seal system.

D. Install sleeves for pipes passing through interior partitions.

1. Cut sleeves to length for mounting flush with both surfaces.
2. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
3. Seal annular space between sleeve and piping or piping insulation; use joint sealants appropriate for size, depth, and location of joint.

E. Fire-Resistance-Rated Penetrations, Horizontal Assembly Penetrations, and Smoke Barrier Penetrations: Maintain indicated fire or smoke rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with fire- and smoke-stop materials. Comply with requirements for firestopping and fill materials specified in Section 078413 "Penetration Firestopping."

3.2 STACK-SLEEVE-FITTING INSTALLATION

A. Install stack-sleeve fittings in new slabs as slabs are constructed.

1. Install fittings that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
2. Secure flashing between clamping flanges for pipes penetrating floors with membrane waterproofing. Comply with requirements for flashing specified in Section 076200 "Sheet Metal Flashing and Trim."
3. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level.

4. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
5. Use silicone sealant to seal the space around outside of stack-sleeve fittings.

B. Fire-Resistance-Rated Penetrations, Horizontal Assembly Penetrations, and Smoke Barrier Penetrations: Maintain indicated fire or smoke rating of floors at pipe penetrations. Seal pipe penetrations with fire- and smoke-stop materials. Comply with requirements for firestopping specified in Section 078413 "Penetration Firestopping."

3.3 SLEEVE-SEAL-SYSTEM INSTALLATION

A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at service piping entries into building.

B. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. Position piping in center of sleeve. Center piping in penetration, assemble sleeve-seal system components, and install in annular space between piping and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make a watertight seal.

3.4 SLEEVE-SEAL-FITTING INSTALLATION

A. Install sleeve-seal fittings in new walls and slabs as they are constructed.

B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange to be centered in concrete slab or wall.

C. Secure nailing flanges to concrete forms.

D. Use grout or silicone sealant to seal the space around outside of sleeve-seal fittings.

3.5 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Leak Test: After allowing for a full cure, test sleeves and sleeve seals for leaks. Repair leaks and retest until no leaks exist.

B. Sleeves and sleeve seals will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports.

3.6 SLEEVE AND SLEEVE-SEAL SCHEDULE

A. Use sleeves and sleeve seals for the following piping-penetration applications:

1. Exterior Concrete Walls above Grade:

a. Piping Smaller Than NPS 6: Cast-iron pipe sleeves, Steel pipe sleeves or Sleeve-seal fittings .

b. Piping NPS 6 and Larger: Cast-iron pipe sleeves, Steel pipe sleeves or Sleeve-seal fittings.

2. Exterior Concrete Walls below Grade:

a. Piping Smaller Than NPS 6 : Cast-iron pipe sleeves with sleeve-seal system, Steel pipe sleeves with sleeve-seal system or Sleeve-seal fittings.

1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.

b. Piping NPS 6 and Larger: Cast-iron pipe sleeves with sleeve-seal system, Steel pipe sleeves with sleeve-seal system or Sleeve-seal fittings .

1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.

3. Concrete Slabs-on-Grade:

a. Piping Smaller Than NPS 6 : Cast-iron pipe sleeves with sleeve-seal system, Steel pipe sleeves with sleeve-seal system, Sleeve-seal fittings .

1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.

b. Piping NPS 6 and Larger: Cast-iron pipe sleeves with sleeve-seal system, Steel pipe sleeves with sleeve-seal system or Sleeve-seal fittings .

1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.

4. Concrete Slabs above Grade:

a. Piping Smaller Than NPS 6 : Steel pipe sleeves, Stack-sleeve fittings or Sleeve-seal fittings .
b. Piping NPS 6 and Larger: Steel pipe sleeves or Stack-sleeve fittings.

5. Interior Partitions:

a. Piping Smaller Than NPS 6 : Steel pipe sleeves.
b. Piping NPS 6 and Larger: Galvanized-steel sheet sleeves.

END OF SECTION 220517

SECTION 220518 - ESCUTCHEONS FOR PLUMBING PIPING

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. Escutcheons.
2. Floor plates.

1.3 DEFINITIONS

A. Existing Piping to Remain: Existing piping that is not to be removed and that is not otherwise indicated to be removed and salvaged, or removed and reinstalled.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 ESCUTCHEONS

A. One-Piece, Steel Type: With polished, chrome-plated or polished brass finish and setscrew fastener.

B. One-Piece, Stainless-Steel Type: With polished stainless-steel finish.

C. One-Piece, Cast-Brass Type: With polished, chrome-plated or polished brass finish and setscrew fastener.

D. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped steel or brass with polished, chrome-plated finish and spring-clip fasteners.

E. One-Piece, Stamped-Steel Type: With polished, chrome-plated finish and spring-clip fasteners.

F. Split-Plate, Stamped-Steel Type: With polished, chrome-plated finish; concealed and exposed-rivet hinge; and spring-clip fasteners.

2.2 FLOOR PLATES

A. Split Floor Plates: Cast brass with concealed hinge.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install escutcheons for piping penetrations of walls, ceilings, and finished floors.

B. Install escutcheons with ID to closely fit around pipe, tube, and insulation of insulated piping and with OD that completely covers opening.

1. Escutcheons for New Piping :

a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep pattern.
b. Chrome-Plated Piping: One-piece steel, cast brass or split-casting brass with polished, chrome-plated finish.
c. Insulated Piping: One-piece steel with polished, chrome-plated or polished brass finish.
d. Insulated Piping: One-piece stainless steel with polished stainless-steel finish.
e. Insulated Piping: One-piece cast brass with polished, chrome-plated or polished brass finish.
f. Insulated Piping: One-piece stamped steel or split-plate, stamped steel with concealed hinge or split-plate, stamped steel with exposed-rivet hinge with polished, chrome-plated finish.
g. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece steel with polished, chrome-plated or polished brass finish.
h. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece stainless steel with polished stainless-steel finish.
i. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece cast brass with polished, chrome-plated or polished brass finish.
j. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece stamped steel or split-plate, stamped steel with concealed hinge or split-plate, stamped steel with exposed-rivet hinge with polished, chrome-plated finish.
k. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece steel with polished, chrome-plated or polished **brass** finish.
l. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece stainless steel with polished stainless-steel finish.
m. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece cast brass with polished, chrome-plated or polished brass finish.
n. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece stamped steel or split-plate, stamped steel with concealed hinge or split-plate, stamped steel with exposed-rivet hinge with polished, chrome-plated finish.
o. Bare Piping in Unfinished Service Spaces: One-piece steel with polished, chrome-plated finish.
p. Bare Piping in Unfinished Service Spaces: One-piece cast brass with polished, chrome-plated or rough-brass finish.
q. Bare Piping in Unfinished Service Spaces: One-piece stamped steel or split-plate, stamped steel with concealed hinge or split-plate, stamped steel with exposed-rivet hinge with polished, chrome-plated finish.
r. Bare Piping in Equipment Rooms: One-piece steel with polished, chrome-plated finish.

s. Bare Piping in Equipment Rooms: One-piece cast brass with polished, chrome-plated or rough-brass finish.
t. Bare Piping in Equipment Rooms: One-piece stamped steel or split-plate, stamped steel with concealed hinge or split-plate, stamped steel with exposed-rivet hinge with polished, chrome-plated finish.

2. Escutcheons for Existing Piping to Remain:

a. Chrome-Plated Piping: Split-casting, stamped steel with concealed or exposed-rivet hinge with polished, chrome-plated finish.
b. Insulated Piping: Split-plate, stamped steel with concealed or exposed-rivet hinge with polished, chrome-plated finish
c. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split-plate, stamped steel with concealed or exposed-rivet hinge with polished, chrome-plated finish.
d. Bare Piping at Ceiling Penetrations in Finished Spaces: Split-plate, stamped steel with concealed or exposed-rivet hinge with polished, chrome-plated finish.
e. Bare Piping in Unfinished Service Spaces: Split-plate, stamped steel with concealed or exposed-rivet hinge with polished, chrome-plated finish.
f. Bare Piping in Equipment Rooms: Split-plate, stamped steel with concealed or exposed-rivet hinge with polished, chrome-plated finish.

C. Install floor plates for piping penetrations of equipment-room floors.

D. Install floor plates with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.

1. New Piping: One-piece, floor plate.
2. Existing Piping: Split floor plate.

3.2 FIELD QUALITY CONTROL

A. Using new materials, replace broken and damaged escutcheons and floor plates.

END OF SECTION 220518

SECTION 220519 - METERS AND GAGES FOR PLUMBING PIPING

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. Bimetallic-actuated thermometers.
2. Filled-system thermometers.
3. Liquid-in-glass thermometers.
4. Light-activated thermometers.
5. Thermowells.
6. Dial-type pressure gages.
7. Gage attachments.
8. Test plugs.
9. Test-plug kits.
10. Sight flow indicators.

B. Related Requirements:

1. Section 221113 "Facility Water Distribution Piping" for domestic water meters and combined domestic and fire-protection water-service meters outside the building.
2. Section 221119 "Domestic Water Piping Specialties" for water meters.
3. Section 221513 "General-Service Compressed-Air Piping" for compressed air gages.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.4 INFORMATIONAL SUBMITTALS

A. Product Certificates: For each type of meter and gage.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For meters and gages to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 BIMETALLIC-ACTUATED THERMOMETERS

A. Standard: ASME B40.200.

B. Case: Liquid-filled and sealed type(s); stainless steel with 3-inch nominal diameter.

C. Dial: Nonreflective aluminum with permanently etched scale markings and scales in deg F and deg C.

D. Connector Type(s): Union joint, adjustable angle rigid, back and rigid, bottom, with unified-inch screw threads.

E. Connector Size: 1/2 inch , with ASME B1.1 screw threads.

F. Stem: 0.25 or 0.375 inch in diameter; stainless steel.

G. Window: Plain glass .

H. Ring: Stainless steel.

I. Element: Bimetal coil.

J. Pointer: Dark-colored metal.

K. Accuracy: Plus or minus 1 percent of scale range.

2.2 FILLED-SYSTEM THERMOMETERS

A. Direct-Mounted, Metal-Case, Vapor-Actuated Thermometers:

1. Standard: ASME B40.200.
2. Case: Sealed type, cast aluminum or drawn steel ; 4-1/2-inch nominal diameter.
3. Element: Bourdon tube or other type of pressure element.
4. Movement: Mechanical, dampening type, with link to pressure element and connection to pointer.
5. Dial: Nonreflective aluminum with permanently etched scale markings graduated in deg F and deg C.
6. Pointer: Dark-colored metal.
7. Window: Glass.
8. Ring: Metal or Stainless steel .
9. Connector Type(s): Union joint, adjustable, 180 degrees in vertical plane, 360 degrees in horizontal plane, with locking device rigid, back and rigid, bottom; with ASME B1.1 screw threads.
10. Thermal System: Liquid-filled bulb in copper-plated steel, aluminum, or brass stem and of length to suit installation.

    a. Design for Thermowell Installation: Bare stem.

11. Accuracy: Plus or minus **1** percent of scale range.

B. Direct-Mounted, Plastic-Case, Vapor-Actuated Thermometers:

1. Standard: ASME B40.200.
2. Case: Sealed type, plastic; 4-1/2-inch nominal diameter.
3. Element: Bourdon tube or other type of pressure element.
4. Movement: Mechanical, with link to pressure element and connection to pointer.
5. Dial: Nonreflective aluminum with permanently etched scale markings graduated in deg F and deg C.
6. Pointer: Dark-colored metal.
7. Window: Glass .
8. Ring: Metal .
9. Connector Type(s): Union joint, adjustable, 180 degrees in vertical plane, 360 degrees in horizontal plane, with locking device rigid, back and rigid, bottom; with ASME B1.1 screw threads.
10. Thermal System: Liquid-filled bulb in copper-plated steel, aluminum, or brass stem and of length to suit installation.

    a. Design for Thermowell Installation: Bare stem.

11. Accuracy: Plus or minus 1 percent of scale range.

C. Remote-Mounted, Metal-Case, Vapor-Actuated Thermometers:

1. Standard: ASME B40.200.
2. Case: Sealed type, cast aluminum or drawn steel ; 4-1/2-inch nominal diameter with back or front flange and holes for panel mounting.
3. Element: Bourdon tube or other type of pressure element.
4. Movement: Mechanical, with link to pressure element and connection to pointer.
5. Dial: Nonreflective aluminum with permanently etched scale markings graduated in deg F and deg C.
6. Pointer: Dark-colored metal.
7. Window: Glass .
8. Ring: Metal or Stainless steel.
9. Connector Type(s): Union joint, back or bottom; with ASME B1.1 screw threads.
10. Thermal System: Liquid-filled bulb in copper-plated steel, aluminum, or brass stem and of length to suit installation.

    a. Design for Thermowell Installation: Bare stem.

11. Accuracy: Plus or minus 1 percent of scale range.

D. Remote-Mounted, Plastic-Case, Vapor-Actuated Thermometers:

1. Standard: ASME B40.200.
2. Case: Sealed type, plastic 4-1/2-inch nominal diameter with back or front flange and holes for panel mounting.
3. Element: Bourdon tube or other type of pressure element.
4. Movement: Mechanical, with link to pressure element and connection to pointer.
5. Dial: Nonreflective aluminum with permanently etched scale markings graduated in deg F and deg C.
6. Pointer: Dark-colored metal.
7. Window: Glass.
8. Ring: Metal.
9. Connector Type(s): Union joint, threaded, back or bottom; with ASME B1.1 screw threads.
10. Thermal System: Liquid-filled bulb in copper-plated steel, aluminum, or brass stem and of length to suit installation.

    a. Design for Thermowell Installation: Bare stem.

11. Accuracy: Plus or minus 1 percent of scale range or one scale division, to a maximum of 1.5 percent of scale range.

2.3 LIQUID-IN-GLASS THERMOMETERS

A. Metal-Case, Compact-Style, Liquid-in-Glass Thermometers:

1. Standard: ASME B40.200.
2. Case: Cast aluminum; 6-inch nominal size.
3. Case Form: Back angle or Straight unless otherwise indicated.
4. Tube: Glass with magnifying lens and blue or red organic liquid.
5. Tube Background: Nonreflective aluminum with permanently etched scale markings graduated in deg F and deg C.
6. Window: Glass or plastic.
7. Stem: Aluminum or brass and of length to suit installation.

    a. Design for Thermowell Installation: Bare stem.

8. Connector: 3/4 inch , with ASME B1.1 screw threads.
9. Accuracy: Plus or minus 1 percent of scale range or one scale division, to a maximum of 1.5 percent of scale range.

B. Metal-Case, Industrial-Style, Liquid-in-Glass Thermometers:

1. Standard: ASME B40.200.
2. Case: Cast aluminum 7-inch nominal size unless otherwise indicated.
3. Case Form: Adjustable angle, Back angle or Straight unless otherwise indicated.
4. Tube: Glass with magnifying lens and blue or red organic liquid.
5. Tube Background: Nonreflective aluminum with permanently etched scale markings graduated in deg F and deg C.
6. Window: Glass.
7. Stem: Aluminum and of length to suit installation.

    a. Design for Thermowell Installation: Bare stem.

8. Connector: 1-1/4 inches, with ASME B1.1 screw threads.
9. Accuracy: Plus or minus 1 percent of scale range or one scale division, to a maximum of 1.5 percent of scale range.

2.4 LIGHT-ACTIVATED THERMOMETERS

A. Direct-Mounted, Light-Activated Thermometers:

1. Case: Metal 7-inch nominal size unless otherwise indicated.
2. Scale(s): Deg F and deg C.
3. Case Form: Adjustable angle.
4. Connector: 1-1/4 inches , with ASME B1.1 screw threads.
5. Stem: Aluminum and of length to suit installation.

    a. Design for Thermowell Installation: Bare stem.

6. Display: Digital.
7. Accuracy: Plus or minus 2 deg F.

B. Remote-Mounted, Light-Activated Thermometers:

1. Case: Plastic, for wall mounting.
2. Scale(s): Deg F and deg C.
3. Sensor: Bulb and thermister wire.

    a. Design for Thermowell Installation: Bare stem.

4. Display: Digital.
5. Accuracy: Plus or minus 2 deg F.

2.5 THERMOWELLS

A. Thermowells:

1. Standard: ASME B40.200.
2. Description: Pressure-tight, socket-type fitting made for insertion into piping tee fitting.
3. Material for Use with Copper Tubing: CNR or CUNI.
4. Material for Use with Steel Piping: CRES or CSA .
5. Type: Stepped shank unless straight or tapered shank is indicated.
6. External Threads: NPS 1/2, NPS 3/4, or NPS 1, ASME B1.20.1 pipe threads.
7. Internal Threads: 1/2, 3/4, and 1 inch, with ASME B1.1 screw threads.
8. Bore: Diameter required to match thermometer bulb or stem.
9. Insertion Length: Length required to match thermometer bulb or stem.
10. Lagging Extension: Include on thermowells for insulated piping and tubing.
11. Bushings: For converting size of thermowell's internal screw thread to size of thermometer connection.

B. Heat-Transfer Medium: Mixture of graphite and glycerin.

2.6 PRESSURE GAGES

A. Direct-Mounted, Metal-Case, Dial-Type Pressure Gages:

1. Standard: ASME B40.100.
2. Case: Liquid-filled Sealed Open-front, pressure relief or Solid-front, pressure relief type(s); cast aluminum or drawn steel; 4-1/2-inch nominal diameter.
3. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.
4. Pressure Connection: Brass, with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
5. Movement: Mechanical, with link to pressure element and connection to pointer.
6. Dial: Nonreflective aluminum with permanently etched scale markings graduated in psi and kPa.
7. Pointer: Dark-colored metal.
8. Window: Glass .
9. Ring: Metal, Brass or Stainless steel.
10. Accuracy: Grade A, plus or minus 1 percent of middle half of scale range.

B. Remote-Mounted, Metal-Case, Dial-Type Pressure Gages:

1. Standard: ASME B40.100.
2. Case: Liquid-filled or Sealed type; cast aluminum or drawn steel; 4-1/2-inch nominal diameter with back or front flange and holes for panel mounting.
3. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.
4. Pressure Connection: Brass, with NPS 1/4 or NPS 1/2 ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
5. Movement: Mechanical, with link to pressure element and connection to pointer.

6. Dial: Nonreflective aluminum with permanently etched scale markings graduated in psi and kPa.
7. Pointer: Dark-colored metal.
8. Window: Glass .
9. Ring: Metal or Stainless steel.
10. Accuracy: Grade A, plus or minus 1 percent of middle half of scale range.

2.7 GAGE ATTACHMENTS

A. Snubbers: ASME B40.100, brass; with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads and [**piston**] [**porous-metal**]-type surge-dampening device. Include extension for use on insulated piping.

B. Valves: Brass or stainless-steel needle, with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads.

2.8 TEST PLUGS

A. Description: Test-station fitting made for insertion into piping tee fitting.

B. Body: Brass or stainless steel with core inserts and gasketed and threaded cap. Include extended stem on units to be installed in insulated piping.

C. Thread Size: NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe thread.

D. Minimum Pressure and Temperature Rating: 500 psig at 200 deg F .

E. Core Inserts: Chlorosulfonated polyethylene synthetic and EPDM self-sealing rubber.

2.9 TEST-PLUG KITS

A. Furnish one test-plug kit(s) containing one thermometer(s), one pressure gage and adapter, and carrying case. Thermometer sensing elements, pressure gage, and adapter probes shall be of diameter to fit test plugs and of length to project into piping.

B. Low-Range Thermometer: Small, bimetallic insertion type with 1- to 2-inch- diameter dial and tapered-end sensing element. Dial range shall be at least 25 to 125 deg F .

C. High-Range Thermometer: Small, bimetallic insertion type with 1- to 2-inch- diameter dial and tapered-end sensing element. Dial range shall be at least 0 to 220 deg F .

D. Pressure Gage: Small, Bourdon-tube insertion type with 2- to 3-inch- diameter dial and probe. Dial range shall be at least 0 to 200 psig .

E. Carrying Case: Metal or plastic, with formed instrument padding.

2.10 SIGHT FLOW INDICATORS

A. Description: Piping inline-installation device for visual verification of flow.

B. Construction: Bronze or stainless-steel body, with sight glass and ball, flapper, or paddle wheel indicator, and threaded or flanged ends.

C. Minimum Pressure Rating: 125 psig .

D. Minimum Temperature Rating: 200 deg F .

E. End Connections for NPS 2 and Smaller: Threaded.

F. End Connections for NPS 2-1/2 and Larger: Flanged.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install thermowells with socket extending a minimum of 2 inches into fluid and in vertical position in piping tees.

B. Install thermowells of sizes required to match thermometer connectors. Include bushings if required to match sizes.

C. Install thermowells with extension on insulated piping.

D. Fill thermowells with heat-transfer medium.

E. Install direct-mounted thermometers in thermowells and adjust vertical and tilted positions.

F. Install remote-mounted thermometer bulbs in thermowells and install cases on panels; connect cases with tubing and support tubing to prevent kinks. Use minimum tubing length.

G. Install direct-mounted pressure gages in piping tees with pressure gage located on pipe at the most readable position.

H. Install remote-mounted pressure gages on panel.

I. Install valve and snubber in piping for each pressure gage for fluids.

J. Install test plugs in piping tees.

K. Install thermometers in the following locations:

1. Inlet and outlet of each water heater.
2. Inlets and outlets of each domestic water heat exchanger.
3. Inlet and outlet of each domestic hot-water storage tank.
4. Inlet and outlet of each remote domestic water chiller.

L. Install pressure gages in the following locations:

1. Building water service entrance into building.
2. Inlet and outlet of each pressure-reducing valve.
3. Suction and discharge of each domestic water pump.

3.2 CONNECTIONS

A. Install meters and gages adjacent to machines and equipment to allow service and maintenance of meters, gages, machines, and equipment.

3.3 ADJUSTING

A. Adjust faces of meters and gages to proper angle for best visibility.

3.4 THERMOMETER SCHEDULE

A. Thermometers at inlet and outlet of each domestic water heater shall be one of the following:

1. Liquid-filled or Sealed, bimetallic-actuated type.
2. Direct or Remote-mounted, metal-case, vapor-actuated type.
3. Metal case, compact-style, liquid-in-glass type.
4. Direct or Remote-mounted, light-activated type.
5. Test plug with chlorosulfonated polyethylene synthetic or EPDM self-sealing rubber inserts.

B. Thermometers at inlet and outlet of each domestic hot-water storage tank shall be one of the following:

1. Liquid-filled or Sealed, bimetallic-actuated type.
2. Direct or Remote-mounted, metal-case, vapor-actuated type.
3. Metal case, compact-style, liquid-in-glass type.
4. Direct or Remote-mounted, light-activated type.
5. Test plug with chlorosulfonated polyethylene synthetic or EPDM self-sealing rubber inserts.

C. Thermometer stems shall be of length to match thermowell insertion length.

3.5 THERMOMETER SCALE-RANGE SCHEDULE

A. Scale Range for Domestic Cold-Water Piping: 0 to 150 deg F.

B. Scale Range for Domestic Hot-Water Piping: 0 to 250 deg F.

3.6 PRESSURE-GAGE SCHEDULE

A. Pressure gages at discharge of each water service into building shall be one of the following:

1. Liquid-filled or Sealed Solid-front, pressure-relief, direct or remote-mounted, metal case.
2. Sealed, direct or remote-mounted, plastic case.
3. Test plug with chlorosulfonated polyethylene synthetic or EPDM self-sealing rubber inserts.

B. Pressure gages at suction and discharge of each domestic water pump shall be one of the following:

1. Liquid-filled or Sealed Solid-front, pressure-relief, direct or remote-mounted, metal case.

2. Sealed, direct or remote-mounted, plastic case.
3. Test plug with chlorosulfonated polyethylene synthetic or EPDM self-sealing rubber inserts.

3.7 PRESSURE-GAGE SCALE-RANGE SCHEDULE

A. Scale Range for Water Service Piping: 0 to 160 psi.

B. Scale Range for Domestic Water Piping: 0 to 160 psi.

END OF SECTION 220519

SECTION 220523.12 - BALL VALVES FOR PLUMBING PIPING

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. Brass ball valves.
2. Bronze ball valves.
3. Steel ball valves.
4. Iron ball valves.

1.3 DEFINITIONS

A. CWP: Cold working pressure.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of valve.

1. Certification that products comply with NSF 61and NSF 372.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:

1. Protect internal parts against rust and corrosion.
2. Protect threads, flange faces, and soldered ends.
3. Set ball valves open to minimize exposure of functional surfaces.

B. Use the following precautions during storage:

1. Maintain valve end protection.
2. Store valves indoors and maintain at higher-than-ambient-dew-point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use operating handles or stems as lifting or rigging points.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.

B. ASME Compliance:

1. ASME B1.20.1 for threads for threaded end valves.
2. ASME B16.1 for flanges on iron valves.
3. ASME B16.5 for flanges on steel valves.
4. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
5. ASME B16.18 for solder-joint connections.
6. ASME B31.9 for building services piping valves.

C. NSF Compliance: NSF 61 and NSF 372 for valve materials for potable-water service.

D. Bronze valves shall be made with dezincification-resistant materials. Bronze valves made with copper alloy (brass) containing more than 15 percent zinc are not permitted.

E. Valve Pressure-Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

F. Valve Sizes: Same as upstream piping unless otherwise indicated.

G. Valves in Insulated Piping:

1. Include 2-inch stem extensions.
2. Extended operating handles of nonthermal-conductive material and protective sleeves that allow operation of valves without breaking vapor seals or disturbing insulation.
3. Memory stops that are fully adjustable after insulation is applied.

2.2 BRASS BALL VALVES

A. Brass Ball Valves, One-Piece:

1. Description:

a. Standard: MSS SP-110.
b. CWP Rating: 400 psig.
c. Body Design: One piece.
d. Body Material: Forged brass or bronze.
e. Ends: Threaded and soldered.
f. Seats: PTFE.
g. Stem: Brass or stainless steel.
h. Ball: Chrome-plated brass or stainless steel.
i. Port: Reduced.

B. Brass Ball Valves, Two-Piece with Full Port and Brass Trim, Threaded or Soldered Ends:

1. Description:

a. Standard: MSS SP-110 or MSS SP-145.
b. CWP Rating: 600 psig.

c. Body Design: Two piece.
d. Body Material: Forged brass.
e. Ends: Threaded and soldered.
f. Seats: PTFE.
g. Stem: Brass.
h. Ball: Chrome-plated brass.
i. Port: Full.

C. Brass Ball Valves, Two-Piece with Full Port and Brass Trim, Press Ends:

1. Description:

a. Standard: MSS SP-110 or MSS SP-145.
b. CWP Rating: Minimum 200 psig.
c. Body Design: Two piece.
d. Body Material: Forged brass.
e. Ends: Press.
f. Press Ends Connections Rating: Minimum 200 psig.
g. Seats: PTFE or RPTFE.
h. Stem: Brass.
i. Ball: Chrome-plated brass.
j. Port: Full.
k. O-Ring Seal: Buna-N or EPDM.

D. Brass Ball Valves, Two-Piece with Full Port and Stainless-Steel Trim, Threaded or Soldered Ends:

1. Description:

a. Standard: MSS SP-110 or MSS SP-145.
b. CWP Rating: 600 psig.
c. Body Design: Two piece.
d. Body Material: Forged brass.
e. Ends: Threaded and soldered.
f. Seats: PTFE.
g. Stem: Stainless steel.
h. Ball: Stainless steel, vented.
i. Port: Full.

E. Brass Ball Valves, Two-Piece with Full Port and Stainless-Steel Trim, Press Ends:

1. Description:

a. Standard: MSS SP-110 or MSS SP-145.
b. CWP Rating: Minimum 200 psig.
c. Body Design: Two piece.
d. Body Material: Forged brass.
e. Ends: Press.
f. Press Ends Connections Rating: Minimum 200 psig.
g. Seats: PTFE or RPTFE.
h. Stem: Stainless steel.
i. Ball: Stainless steel, vented.
j. Port: Full.
k. O-Ring Seal: Buna-N or EPDM.

F. Brass Ball Valves, Two-Piece with Regular Port and Brass Trim:

1. Description:

a. Standard: MSS SP-110.
b. CWP Rating: 600 psig.
c. Body Design: Two piece.
d. Body Material: Forged brass.
e. Ends: Threaded and soldered.
f. Seats: PTFE.
g. Stem: Brass.
h. Ball: Chrome-plated brass.
i. Port: Regular.

G. Brass Ball Valves, Two-Piece with Regular Port and Stainless-Steel Trim:

1. Description:

a. Standard: MSS SP-110.
b. CWP Rating: 600 psig.
c. Body Design: Two piece.
d. Body Material: Brass or bronze.
e. Ends: Threaded and soldered.
f. Seats: PTFE.
g. Stem: Stainless steel.
h. Ball: Stainless steel, vented.
i. Port: Regular.

H. Brass Ball Valves, Three-Piece with Full Port and Brass Trim:

1. Description:

a. Standard: MSS SP-110.
b. CWP Rating: 600 psig.
c. Body Design: Three piece.
d. Body Material: Forged brass.
e. Ends: Threaded and soldered.
f. Seats: PTFE.
g. Stem: Brass.
h. Ball: Chrome-plated brass.
i. Port: Full.

I. Brass Ball Valves, Three-Piece with Full Port and Stainless-Steel Trim:

1. Description:

a. Standard: MSS SP-110.
b. CWP Rating: 600 psig.
c. Body Design: Three piece.
d. Body Material: Forged brass.
e. Ends: Threaded and soldered.
f. Seats: PTFE.
g. Stem: Stainless steel.
h. Ball: Stainless steel, vented.
i. Port: Full.

2.3 BRONZE BALL VALVES

A. Bronze Ball Valves, One-Piece with Bronze Trim:

1. Description:

a. Standard: MSS SP-110.
b. CWP Rating: 400 psig.
c. Body Design: One piece.
d. Body Material: Bronze.
e. Ends: Threaded.
f. Seats: PTFE.
g. Stem: Bronze.
h. Ball: Chrome-plated brass.
i. Port: Reduced.

B. Bronze Ball Valves, One-Piece with Stainless-Steel Trim:

1. Description:

a. Standard: MSS SP-110.
b. CWP Rating: 600 psig.
c. Body Design: One piece.
d. Body Material: Bronze.
e. Ends: Threaded.
f. Seats: PTFE.
g. Stem: Stainless steel.
h. Ball: Stainless steel, vented.
i. Port: Reduced.

C. Bronze Ball Valves, Two-Piece with Full Port, and Bronze or Brass Trim, Threaded or Soldered Ends:

1. Description:

a. Standard: MSS SP-110 or MSS-145.
b. CWP Rating: 600 psig.
c. Body Design: Two piece.
d. Body Material: Bronze.
e. Ends: Threaded and soldered.
f. Seats: PTFE.
g. Stem: Bronze or brass.
h. Ball: Chrome-plated brass.
i. Port: Full.

D. Bronze Ball Valves, Two-Piece with Full Port, and Bronze or Brass Trim, Press Ends:

1. Description:

a. Standard: MSS SP-110 or MSS-145.
b. CWP Rating: Minimum 200 psig.
c. Body Design: Two piece.
d. Body Material: Bronze.
e. Ends: Press.
f. Press Ends Connections Rating: Minimum 200 psig.
g. Seats: PTFE or RTPFE.
h. Stem: Bronze or brass.
i. Ball: Chrome-plated brass.
j. Port: Full.
k. O-Ring Seal: EPDM or Buna-N.

E. Bronze Ball Valves, Two-Piece with Full Port and Stainless-Steel Trim:

1. Description:

a. Standard: MSS SP-110 or MSS-145.
b. CWP Rating: 600 psig.
c. Body Design: Two piece.
d. Body Material: Bronze.
e. Ends: Threaded or soldered.
f. Seats: PTFE.
g. Stem: Stainless steel.
h. Ball: Stainless steel, vented.
i. Port: Full.

F. Bronze Ball Valves, Two-Piece with Regular Port and Bronze or Brass Trim:

1. Description:

a. Standard: MSS SP-110.
b. CWP Rating: 600 psig.
c. Body Design: Two piece.
d. Body Material: Bronze.
e. Ends: Threaded.
f. Seats: PTFE.
g. Stem: Bronze or brass.
h. Ball: Chrome-plated brass.
i. Port: Regular.

G. Bronze Ball Valves, Two-Piece with Regular Port and Stainless-Steel Trim:

1. Description:

a. Standard: MSS SP-110.
b. CWP Rating: 600 psig.
c. Body Design: Two piece.
d. Body Material: Bronze.
e. Ends: Threaded.
f. Seats: PTFE.
g. Stem: Stainless steel.
h. Ball: Stainless steel, vented.
i. Port: Regular.

H. Bronze Ball Valves, Three-Piece with Full Port and Bronze or Brass Trim:

1. Description:

a. Standard: MSS SP-110.
b. CWP Rating: 600 psig.
c. Body Design: Three piece.
d. Body Material: Bronze.
e. Ends: Threaded.
f. Seats: PTFE.
g. Stem: Bronze or brass.
h. Ball: Chrome-plated brass.
i. Port: Full.

I. Bronze Ball Valves, Three-Piece with Full Port and Stainless-Steel Trim:

1. Description:

a. Standard: MSS SP-110.
b. CWP Rating: 600 psig.

c. Body Design: Three piece.
d. Body Material: Bronze.
e. Ends: Threaded.
f. Seats: PTFE.
g. Stem: Stainless steel.
h. Ball: Stainless steel, vented.
i. Port: Full.

J. Bronze Ball Valves, Three-Piece with Regular Port and Bronze Trim:

1. Description:

a. Standard: MSS SP-110.
b. CWP Rating: 600 psig.
c. Body Design: Three piece
d. Body Material: Bronze
e. Ends: Threaded or soldered.
f. Seats: PTFE.
g. Stem: Bronze.
h. Ball: Chrome-plated brass.
i. Port: Regular.

K. Bronze Ball Valves, Three-Piece with Regular Port and Stainless-Steel Trim:

1. Description:

a. Standard: MSS SP-110.
b. CWP Rating: 600 psig.
c. Body Design: Three piece.
d. Body Material: Bronze.
e. Ends: Threaded or soldered.
f. Seats: PTFE.
g. Stem: Stainless steel.
h. Ball: Stainless steel, vented.
i. Port: Regular.

2.4 STEEL BALL VALVES

A. Steel Ball Valves with Full Port, Class 150:

1. Description:

a. Standard: MSS SP-72.
b. CWP Rating: 285 psig.
c. Body Design: Split body.
d. Body Material: Carbon steel, ASTM A216, Type WCB.
e. Ends: Flanged or threaded.
f. Seats: PTFE.
g. Stem: Stainless steel.
h. Ball: Stainless steel, vented.
i. Port: Full.

B. Steel Ball Valves with Regular Port, Class 150:

1. Description:

a. Standard: MSS SP-72.

b. CWP Rating: 285 psig.
c. Body Design: Uni-body.
d. Body Material: Carbon steel, ASTM A216, Type WCB.
e. Ends: Flanged or threaded.
f. Seats: PTFE.
g. Stem: Stainless steel.
h. Ball: Stainless steel, vented.
i. Port: Regular.

2.5 IRON BALL VALVES

A. Iron Ball Valves, Class 125:

1. Description:

a. Standard: MSS SP-72.
b. CWP Rating: 200 psig.
c. Body Design: Split body.
d. Body Material: ASTM A126, gray iron.
e. Ends: Flanged or threaded.
f. Seats: PTFE.
g. Stem: Stainless steel.
h. Ball: Stainless steel.
i. Port: Full.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.

B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.

C. Examine threads on valve and mating pipe for form and cleanliness.

D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.

E. Do not attempt to repair defective valves; replace with new valves.

3.2 VALVE INSTALLATION

A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.

B. Locate valves for easy access and provide separate support where necessary.

C. Install valves in horizontal piping with stem at or above center of pipe.

D. Install valves in position to allow full stem movement.

E. Install valve tags. Comply with requirements in Section 220553 "Identification for Plumbing Piping and Equipment" for valve tags and schedules.

3.3 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

A. If valves with specified CWP ratings are unavailable, the same types of valves with higher CWP ratings may be substituted.

B. Select valves with the following end connections:

1. For Copper Tubing, NPS 2 and Smaller: Threaded ends except where solder-joint valve-end option or press-end option is indicated in valve schedules below.
2. For Copper Tubing, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
3. For Copper Tubing, NPS 6 and Larger: Flanged ends.
4. For Steel Piping, NPS 2 and Smaller: Threaded ends.
5. For Steel Piping, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
6. For Steel Piping, NPS 6 and Larger: Flanged ends.

3.4 LOW-PRESSURE, COMPRESSED-AIR VALVE SCHEDULE 150 PSIG OR LESS

A. Pipe NPS 2 and Smaller:

1. Bronze and Brass Valves: May be provided with solder-joint ends instead of threaded ends.
2. Brass ball valves, one piece.
3. Bronze ball valves, one piece with bronze or stainless steel trim.
4. Brass ball valves, two-piece with full port and brass or stainless steel trim.
5. Bronze ball valves, two-piece with full port and bronze or brass or stainless steel trim.
6. Brass ball valves, three-piece with full port and brass or stainless steel trim.
7. Bronze ball valve, three-piece with full port and bronze or brass or stainless steel trim.
8. Bronze ball valves, two-piece with regular port and bronze or stainless steel trim.

B. Pipe NPS 2-1/2 and Larger:

1. Steel and Iron Valves, NPS 2-1/2 to NPS 4: May be provided with threaded ends instead of flanged ends.
2. Steel ball valves, Class 150 with full port.
3. Iron ball valves, Class 150.

3.5 HIGH-PRESSURE, COMPRESSED-AIR VALVE SCHEDULE 150 TO 200 PSIG

A. Pipe NPS 2 and Smaller:

1. Bronze and Brass Valves: May be provided with solder-joint ends instead of threaded ends.
2. Brass ball valve.
3. Bronze ball valve, one piece with bronze or stainless steel trim.
4. Brass ball valves, two-piece with full port and brass or stainless steel trim.

5. Bronze ball valves, two-piece with full port and bronze or brass or stainless steel trim.
6. Brass ball valves, three-piece with full port and brass or stainless steel trim.
7. Bronze ball valves, three-piece with full port and bronze or brass or stainless steel trim.
8. Bronze ball valves, two-piece with regular port and bronze or stainless steel trim.

B. Pipe NPS 2-1/2 and Larger:

1. Steel and Iron Valves, NPS 2-1/2 to NPS 4: May be provided with threaded ends instead of flanged ends.
2. Steel ball valves, Class 150 with full port.
3. Iron ball valves, Class 150.

3.6 DOMESTIC HOT- AND COLD-WATER VALVE SCHEDULE

A. Pipe NPS 2 and Smaller:

1. Brass ball valve, one piece. Provide with threaded or solder-joint ends.
2. Bronze ball valve, one piece with bronze or stainless steel trim. Provide with threaded or solde]-joint ends.
3. Brass ball valves, two-piece with full port and brass or stainless steel trim. Provide with threaded, solder or press connection-joint ends.
4. Bronze ball valves, two-piece with full port and bronze or brass or stainless steel trim. Provide with threaded, solder or press connection-joint ends.
5. Brass ball valves, three-piece with full port and brass or stainless steel trim.
6. Bronze ball valves, three-piece with full port and bronze or brass or stainless steel trim.
7. Bronze ball valves, two-piece with regular port and bronze or stainless-steel trim.

B. Pipe NPS 2-1/2 and Larger:

1. Steel and Iron Valves, NPS 2-1/2 to NPS 4: May be provided with threaded ends instead of flanged ends.
2. Steel ball valves, Class 150 with full port.
3. Iron ball valves, Class 150.

END OF SECTION 220523.12

SECTION 220523.13 - BUTTERFLY VALVES FOR PLUMBING PIPING

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. Iron, single-flange butterfly valves.
2. Iron, grooved-end butterfly valves.

1.3 DEFINITIONS

A. CWP: Cold working pressure.

B. EPDM: Ethylene propylene-diene terpolymer rubber.

C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of valve.

1. Certification that products comply with NSF 61 Annex G and NSF 372.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:

1. Protect internal parts against rust and corrosion.
2. Protect threads, flange faces, grooves, and weld ends.
3. Set butterfly valves closed or slightly open.

B. Use the following precautions during storage:

1. Maintain valve end protection.
2. Store valves indoors and maintain at higher-than-ambient-dew-point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.

B. ASME Compliance:

1. ASME B16.1 for flanges on iron valves.
2. ASME B16.5 for flanges on steel valves.
3. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
4. ASME B31.9 for building service piping valves.

C. AWWA Compliance: Comply with AWWA C606 for grooved-end connections.

D. NSF Compliance: NSF 61 Annex G and NSF 372 for valve materials for potable-water service.

E. Valve Pressure-Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

F. Valve Sizes: Same as upstream piping unless otherwise indicated.

G. Valves in Insulated Piping: With 2-inch stem extensions.

2.2 IRON, SINGLE-FLANGE BUTTERFLY VALVES

A. Iron, Single-Flange Butterfly Valves with Aluminum-Bronze Disc:

1. Description:

a. Standard: MSS SP-67, Type I.
b. CWP Rating: 200 psig .
c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
d. Body Material: ASTM A126, cast iron or ASTM A536, ductile iron.
e. Seat: EPDM or NBR.
f. Stem: One- or two-piece stainless steel.
g. Disc: Aluminum bronze.

B. Iron, Single-Flange Butterfly Valves with Ductile-Iron Disc:

1. Description:

a. Standard: MSS SP-67, Type I.
b. CWP Rating: 200 psig.
c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
d. Body Material: ASTM A126, cast iron or ASTM A536, ductile iron.
e. Seat: EPDM or NBR.
f. Stem: One- or two-piece stainless steel.
g. Disc: Nickel-plated or nickel-coated ductile iron.

C. Iron, Single-Flange Butterfly Valves with Stainless-Steel Disc:

1. Description:

   a. Standard: MSS SP-67, Type I.
   b. CWP Rating, NPS 12 and Smaller: 200 psig .
   c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
   d. Body Material: ASTM A126, cast iron or ASTM A536, ductile iron.
   e. Seat: EPDM or NBR.
   f. Stem: One- or two-piece stainless steel.
   g. Disc: Stainless steel.

2.3 DUCTILE-IRON, GROOVED-END BUTTERFLY VALVES

A. Ductile Iron, Grooved-End Butterfly Valves, 175 CWP:

1. Description:

   a. Standard: MSS SP-67, Type I.
   b. CWP Rating: 175 psig.
   c. Body Material: Coated, ductile iron.
   d. Stem: Two-piece stainless steel.
   e. Disc: Coated, ductile iron.
   f. Seal: EPDM.

B. Ductile Iron, Grooved-End Butterfly Valves, 300 CWP:

1. Description:

   a. Standard: MSS SP-67, Type I.
   b. CWP Rating, NPS 8 and Smaller: 300 psig.
   c. Body Material: Coated, ductile iron.
   d. Stem: Two-piece stainless steel.
   e. Disc: Coated, ductile iron.
   f. Seal: EPDM or NBR.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.

B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.

C. Examine mating flange faces for damage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.

D. Do not attempt to repair defective valves; replace with new valves.

3.2 VALVE INSTALLATION

A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.

B. Locate valves for easy access and provide separate support where necessary.

C. Install valves in horizontal piping with stem at or above center of pipe.

D. Install valves in position to allow full stem movement.

E. Install valve tags. Comply with requirements in Section 220553 "Identification for Plumbing Piping and Equipment" for valve tags and schedules.

3.3 ADJUSTING

A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

3.4 LOW-PRESSURE, COMPRESSED-AIR VALVE SCHEDULE 150 PSIG OR LESS

A. Pipe NPS 2-1/2 and Larger:

1. Iron, Single-Flange Butterfly Valves: 200 CWP, NBR seat, aluminum-bronze, ductile-iron or stainless-steel disc.
2. Ductile-Iron, Grooved-End Butterfly Valves: 175 CWP.

3.5 HIGH-PRESSURE, COMPRESSED-AIR VALVE SCHEDULE 150 TO 200 PSIG

A. Pipe NPS 2-1/2 and Larger:

1. Iron, Single-Flange Butterfly Valves: 200 CWP, NBR seat, aluminum-bronze, ductile-iron or stainless-steel disc.
2. Ductile-Iron, Grooved-End Butterfly Valves: 175 CWP.

3.6 DOMESTIC HOT- AND COLD-WATER VALVE SCHEDULE

A. Pipe NPS 2-1/2 and Larger:

1. Iron, Single-Flange Butterfly Valves: 200 CWP, EPDM or NBR seat, aluminum-bronze, ductile-iron or stainless-steel disc.
2. Ductile-Iron, Grooved-End Butterfly Valves: 175 CWP.

END OF SECTION 220523.13

SECTION 220523.14 - CHECK VALVES FOR PLUMBING PIPING

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. Bronze lift check valves.
2. Bronze swing check valves.
3. Bronze swing check valves, press ends.
4. Iron swing check valves.
5. Iron, grooved-end swing check valves.
6. Iron, center-guided check valves.

1.3 DEFINITIONS

A. CWP: Cold working pressure.

B. EPDM: Ethylene propylene-diene terpolymer rubber.

C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of valve.

1. Certification that products comply with NSF 61 and NSF 372.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:

1. Protect internal parts against rust and corrosion.
2. Protect threads, flange faces, grooves, and weld ends.
3. Set check valves in either closed or open position.

B. Use the following precautions during storage:

1. Maintain valve end protection.
2. Store valves indoors and maintain at higher-than-ambient-dew-point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.

B. ASME Compliance:

1. ASME B1.20.1 for threads for threaded end valves.
2. ASME B16.1 for flanges on iron valves.
3. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
4. ASME B16.18 for solder joint.
5. ASME B31.9 for building services piping valves.

C. AWWA Compliance: Comply with AWWA C606 for grooved-end connections.

D. Drinking Water System Components - Health Effects and Drinking Water System Components - Lead Content Compliance: NSF 61 and NSF 372.

E. Bronze valves shall be made with dezincification-resistant materials. Bronze valves made with copper alloy (brass) containing more than 15 percent zinc are not permitted.

F. Valve Pressure-Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

G. Valve Sizes: Same as upstream piping unless otherwise indicated.

H. Valve Bypass and Drain Connections: MSS SP-45.

2.2 BRONZE LIFT CHECK VALVES

A. Bronze Lift Check Valves with Bronze Disc, Class 125:

1. Description:

a. Standard: MSS SP-80, Type 1.
b. CWP Rating: 200 psig.
c. Body Design: Vertical flow.
d. Body Material: ASTM B61 or ASTM B62, bronze.
e. Ends: Threaded or soldered. See valve schedule articles.
f. Disc: Bronze.

B. Bronze Lift Check Valves with Nonmetallic Disc, Class 125:

1. Description:

a. Standard: MSS SP-80, Type 2.
b. CWP Rating: 200 psig.
c. Body Design: Vertical flow.

d. Body Material: ASTM B61 or ASTM B62, bronze.
e. Ends: Threaded or soldered. See valve schedule articles.
f. Disc: NBR, PTFE.

2.3 BRONZE SWING CHECK VALVES

A. Bronze Swing Check Valves with Bronze Disc, Class 125:

1. Description:

a. Standard: MSS SP-80, Type 3.
b. CWP Rating: 200 psig.
c. Body Design: Horizontal flow.
d. Body Material: ASTM B62, bronze.
e. Ends: Threaded or soldered. See valve schedule articles.
f. Disc: Bronze.

B. Bronze Swing Check Valves with Nonmetallic Disc, Class 125:

1. Description:

a. Standard: MSS SP-80, Type 4.
b. CWP Rating: 200 psig.
c. Body Design: Horizontal flow.
d. Body Material: ASTM B62, bronze.
e. Ends: Threaded or soldered. See valve schedule articles.
f. Disc: PTFE.

C. Bronze Swing Check Valves with Bronze Disc, Class 150:

1. Description:

a. Standard: MSS SP-80, Type 3.
b. CWP Rating: 300 psig.
c. Body Design: Horizontal flow.
d. Body Material: ASTM B62, bronze.
e. Ends: Threaded or soldered. See valve schedule articles.
f. Disc: Bronze.

D. Bronze Swing Check Valves with Nonmetallic Disc, Class 150:

1. Description:

a. Standard: MSS SP-80, Type 4.
b. CWP Rating: 300 psig.
c. Body Design: Horizontal flow.
d. Body Material: ASTM B62, bronze.
e. Ends: Threaded or soldered. See valve schedule articles.
f. Disc: PTFE.

E. Bronze Swing Check Valves, Press Ends:

1. Description:

a. Standard: MSS SP-80 and MSS SP-139.
b. CWP Rating: Minimum 200 psig.
c. Body Design: Horizontal flow.

d. Body Material: ASTM B584, bronze.
e. Ends: Press.
f. Press Ends Connection Rating: Minimum 200 psig.
g. Disc: Brass or bronze.

2.4 IRON SWING CHECK VALVES

A. Iron Swing Check Valves with Metal Seats, Class 125:

1. Description:

a. Standard: MSS SP-71, Type I.
b. CWP Rating: 200 psig.
c. Body Design: Clear or full waterway.
d. Body Material: ASTM A126, gray iron with bolted bonnet.
e. Ends: Flanged or threaded. See valve schedule articles.
f. Trim: Bronze.
g. Gasket: Asbestos free.

B. Iron Swing Check Valves with Nonmetallic-to-Metal Seats, Class 125:

1. Description:

a. Standard: MSS SP-71, Type I.
b. CWP Rating: 200 psig.
c. Body Design: Clear or full waterway.
d. Body Material: ASTM A126, gray iron with bolted bonnet.
e. Ends: Flanged or threaded. See valve schedule articles.
f. Trim: Composition.
g. Seat Ring: Bronze.
h. Disc Holder: Bronze.
i. Disc: PTFE.
j. Gasket: Asbestos free.

C. Iron Swing Check Valves with Metal Seats, Class 250:

1. Description:

a. Standard: MSS SP-71, Type I.
b. CWP Rating: 500 psig.
c. Body Design: Clear or full waterway.
d. Body Material: ASTM A126, gray iron with bolted bonnet.
e. Ends: Flanged or threaded. See valve schedule articles.
f. Trim: Bronze.
g. Gasket: Asbestos free.

2.5 IRON, GROOVED-END SWING CHECK VALVES

A. Iron, Grooved-End Swing Check Valves, 300 CWP:

1. Description:

a. CWP Rating: 300 psig.
b. Body Material: ASTM A536, ductile iron.
c. Seal: EPDM.
d. Disc: Spring operated, ductile iron or stainless steel.

2.6 IRON, CENTER-GUIDED, SPRING-LOADED CHECK VALVES

A. Iron, Compact-Wafer, Center-Guided Check Valves with Metal Seat, Class 125:

1. Description:

a. Standard: MSS SP-125.
b. CWP Rating: 200 psig.
c. Body Material: ASTM A126, gray iron.
d. Style: Compact wafer, spring loaded.
e. Seat: Bronze.

B. Iron Globe, Center-Guided Check Valves with Metal Seat, Class 125:

1. Description:

a. Standard: MSS SP-125.
b. CWP Rating: 200 psig.
c. Body Material: ASTM A126, gray iron.
d. Style: Globe, spring loaded.
e. Ends: Flanged.
f. Seat: Bronze.

C. Iron, Compact-Wafer, Center-Guided Check Valves with Metal Seat, Class 150:

1. Description:

a. Standard: MSS SP-125.
b. CWP Rating: 300 psig.
c. Body Material: ASTM A395/A395M or ASTM A536, ductile iron.
d. Style: Compact wafer, spring loaded.
e. Seat: Bronze.

D. Iron Globe, Center-Guided Check Valves with Metal Seat, Class 150:

1. Description:

a. Standard: MSS SP-125.
b. CWP Rating: 300 psig.
c. Body Material: ASTM A395/A395M or ASTM A536, ductile iron.
d. Style: Globe, spring loaded.
e. Ends: Flanged.
f. Seat: Bronze.

E. Iron, Compact-Wafer, Center-Guided Check Valves with Metal Seat, Class 250:

1. Description:

a. Standard: MSS SP-125.
b. CWP Rating: 400 psig.
c. Body Material: ASTM A126, gray iron.
d. Style: Compact wafer, spring loaded.
e. Seat: Bronze.

F. Iron Globe, Center-Guided Check Valves with Metal Seat, Class 250:

1. Description:

a. Standard: MSS SP-125.

b. CWP Rating: 400 psig.
c. Body Material: ASTM A126, gray iron.
d. Style: Globe, spring loaded.
e. Ends: Flanged.
f. Seat: Bronze.

G. Iron, Compact-Wafer, Center-Guided Check Valves with Metal Seat, Class 300:

1. Description:

a. Standard: MSS SP-125.
b. CWP Rating: 500 psig.
c. Body Material: ASTM A395/A395M or ASTM A536, ductile iron.
d. Style: Compact wafer, spring loaded.
e. Seat: Bronze.

H. Iron Globe, Center-Guided Check Valves with Metal Seat, Class 300:

1. Description:

a. Standard: MSS SP-125.
b. CWP Rating: 500 psig .
c. Body Material: ASTM A395/A395M or ASTM A536, ductile iron.
d. Style: Globe, spring loaded.
e. Ends: Flanged.
f. Seat: Bronze.

I. Iron, Compact-Wafer, Center-Guided Check Valves with Resilient Seat, Class 125:

1. Description:

a. Standard: MSS SP-125.
b. CWP Rating: 200 psig.
c. Body Material: ASTM A126, gray iron.
d. Style: Compact wafer, spring loaded.
e. Seat: EPDM or NBR.

J. Iron Globe, Center-Guided Check Valves with Resilient Seat, Class 125:

1. Description:

a. Standard: MSS SP-125.
b. CWP Rating: 200 psig.
c. Body Material: ASTM A126, gray iron.
d. Style: Globe, spring loaded.
e. Ends: Flanged.
f. Seat: EPDM or NBR .

K. Iron, Compact-Wafer, Center-Guided Check Valves with Resilient Seat, Class 150:

1. Description:

a. Standard: MSS SP-125.
b. CWP Rating: 300 psig.
c. Body Material: ASTM A395/A395M or ASTM A536, ductile iron.
d. Style: Compact wafer, spring loaded.
e. Seat: EPDM or NBR.

L. Iron, Globe, Center-Guided Check Valves with Resilient Seat, Class 150:

1. Description:

a. Standard: MSS SP-125.
b. CWP Rating: 300 psig.
c. Body Material: ASTM A395/A395M or ASTM A536, ductile iron.
d. Style: Globe, spring loaded.
e. Ends: Flanged.
f. Seat: EPDM or NBR.

M. Iron, Compact-Wafer, Center-Guided Check Valves with Resilient Seat, Class 250:

1. Description:

a. Standard: MSS SP-125.
b. CWP Rating: 400 psig .
c. Body Material: ASTM A126, gray iron.
d. Style: Compact wafer, spring loaded.
e. Seat: EPDM or NBR .

N. Iron Globe, Center-Guided Check Valves with Resilient Seat, Class 250:

1. Description:

a. Standard: MSS SP-125.
b. CWP Rating: 400 psig.
c. Body Material: ASTM A126, gray iron.
d. Style: Globe, spring loaded.
e. Ends: Flanged.
f. Seat: EPDM or NBR .

O. Iron, Compact-Wafer, Center-Guided Check Valves with Resilient Seat, Class 300:

1. Description:

a. Standard: MSS SP-125.
b. CWP Rating: 500 psig.
c. Body Material: ASTM A395/A395M or ASTM A536, ductile iron.
d. Style: Compact wafer, spring loaded.
e. Seat: EPDM or NBR.

P. Iron Globe, Center-Guided Check Valves with Resilient Seat, Class 300:

1. Description:

a. Standard: MSS SP-125.
b. CWP Rating: 500 psig .
c. Body Material: ASTM A395/A395M or ASTM A536, ductile iron.
d. Style: Globe, spring loaded.
e. Ends: Flanged.
f. Seat: EPDM or NBR .

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.

B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.

C. Examine threads on valve and mating pipe for form and cleanliness.

D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.

E. Do not attempt to repair defective valves; replace with new valves.

3.2 VALVE INSTALLATION

A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.

B. Locate valves for easy access and provide separate support where necessary.

C. Install valves in horizontal piping with stem at or above center of pipe.

D. Install valves in position to allow full stem movement.

E. Check Valves: Install check valves for proper direction of flow.

1. Swing Check Valves: In horizontal position with hinge pin level.
2. Center-Guided Check Valves: In horizontal or vertical position, between flanges.
3. Lift Check Valves: With stem upright and plumb.

F. Install valve tags. Comply with requirements in Section 220553 "Identification for Plumbing Piping and Equipment" for valve tags and schedules.

3.3 ADJUSTING

A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

3.4 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

A. If valve applications are not indicated, use the following:

1. Pump-Discharge Check Valves:

a. NPS 2 and Smaller: Bronze swing check valves with bronze disc.

B. If valves with specified CWP ratings are unavailable, the same types of valves with higher CWP ratings may be substituted.

C. End Connections:

1. For Copper Tubing, NPS 2 and Smaller: Threaded or soldered or press-ends.
2. For Copper Tubing, NPS 2-1/2 to NPS 4: Flanged or threaded.
3. For Copper Tubing, NPS 6 and Larger: Flanged.
4. For Steel Piping, NPS 2 and Smaller: Threaded.
5. For Steel Piping, NPS 2-1/2 to NPS 4: Flanged or threaded.
6. For Steel Piping, NPS 6 and Larger: Flanged.
7. For Grooved-End Copper Tubing and Steel Piping: Grooved.

3.5 LOW-PRESSURE, COMPRESSED-AIR VALVE SCHEDULE 150 PSIG OR LESS

A. Pipe NPS 2 and Smaller:

1. Vertical, Upflow Applications Only: Bronze lift check valves with bronze disc, Class 125, with soldered or threaded end connections.
2. Horizontal and Vertical Applications: Bronze swing check valves with bronze disc, Class 125, with soldered or threaded end connections.

3.6 HIGH-PRESSURE, COMPRESSED-AIR VALVE SCHEDULE 150 TO 200 PSIG

A. Pipe NPS 2 and Smaller:

1. Vertical, Upflow Applications Only: Bronze lift check valves with bronze disc, Class 125, with soldered or threaded end connections.
2. Horizontal and Vertical Applications: Bronze swing check valves with bronze disc, Class 125, with soldered or threaded end connections.

3.7 DOMESTIC HOT- AND COLD-WATER VALVE SCHEDULE

A. Pipe NPS 2 and Smaller:

1. Bronze swing check valves with bronze disc, Class 125, with soldered or threaded end connections.
2. Bronze swing check valves with press-end connections.

B. Pipe NPS 2-1/2 and Larger:

1. Iron swing check valves with metal seats, Class 125, with threaded or flanged end connections.
2. Iron swing check valves with closure control lever and spring or weight, Class 125, with threaded or flanged end connections.
3. Iron, grooved-end swing check valves, 300 CWP.
4. Iron, center-guided check valves with compact wafer, Class 125.
5. Iron, center-guided check valves with globe, metal or resilient seat, Class 125, with threaded or flanged end connections.

END OF SECTION 220523.14

SECTION 220523.15 - GATE VALVES FOR PLUMBING PIPING

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. Bronze gate valves.
2. Iron gate valves.
3. CPVC gate valves.
4. PVC gate valves.
5. Chainwheels.

1.3 DEFINITIONS

A. CWP: Cold working pressure.

B. NRS: Nonrising stem.

C. OS&Y: Outside screw and yoke.

D. RS: Rising stem.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of valve.

1. Certification that products comply with NSF 61 and NSF 372.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:

1. Protect internal parts against rust and corrosion.
2. Protect threads, flange faces, grooves, and weld ends.
3. Set gate valves closed to prevent rattling.

B. Use the following precautions during storage:

1. Maintain valve end protection.
2. Store valves indoors and maintain at higher-than-ambient-dew-point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.

B. ASME Compliance:

1. ASME B1.20.1 for threads for threaded end valves.
2. ASME B16.1 for flanges on iron valves.
3. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
4. ASME B16.18 for solder joint.
5. ASME B31.9 for building services piping valves.

C. NSF Compliance: NSF 61 and NSP 372 for valve materials for potable-water service.

D. Bronze valves shall be made with dezincification-resistant materials. Bronze valves made with copper alloy (brass) containing more than 15 percent zinc are not permitted.

E. Valve Pressure-Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

F. Valve Sizes: Same as upstream piping unless otherwise indicated.

G. RS Valves in Insulated Piping: With 2-inch stem extensions.

H. Valve Bypass and Drain Connections: MSS SP-45.

2.2 BRONZE GATE VALVES

A. Bronze Gate Valves, NRS, Class 125:

1. Description:

a. Standard: MSS SP-80, Type 1.
b. CWP Rating: 200 psig.
c. Body Material: Bronze with integral seat and screw-in bonnet.
d. Ends: Threaded or solder joint.
e. Stem: Bronze.
f. Disc: Solid wedge; bronze.
g. Packing: Asbestos free.
h. Handwheel: Malleable iron, bronze, or aluminum.

B. Bronze Gate Valves, RS, Class 125:

1. Description:

a. Standard: MSS SP-80, Type 2.
b. CWP Rating: 200 psig.

c. Body Material: Bronze with integral seat and screw-in bonnet.
d. Ends: Threaded or solder joint.
e. Stem: Bronze.
f. Disc: Solid wedge; bronze.
g. Packing: Asbestos free.
h. Handwheel: Malleable iron, bronze, or aluminum.

C. Bronze Gate Valves, NRS, Class 150:

1. Description:

a. Standard: MSS SP-80, Type 1.
b. CWP Rating: 300 psig.
c. Body Material: Bronze with integral seat and union-ring bonnet.
d. Ends: Threaded.
e. Stem: Bronze.
f. Disc: Solid wedge; bronze.
g. Packing: Asbestos free.
h. Handwheel: Malleable iron, bronze, or aluminum.

D. Bronze Gate Valves, RS, Class 150:

1. Description:

a. Standard: MSS SP-80, Type 2.
b. CWP Rating: 300 psig.
c. Body Material: Bronze with integral seat and union-ring bonnet.
d. Ends: Threaded.
e. Stem: Bronze.
f. Disc: Solid wedge; bronze.
g. Packing: Asbestos free.
h. Handwheel: Malleable iron, bronze, or aluminum.

E. Bronze Gate Valves, Press Ends:

1. Description:

a. Standard: MSS SP-80 and MSS SP-139.
b. CWP Rating: Minimum 200 psig.
c. Body Material: Bronze with integral seat and union-ring bonnet.
d. Ends: Press.
e. Press Ends Connection Rating: Minimum 200 psig.
f. Stem: Brass or bronze rising or non-rising.
g. Disc: Solid wedge; bronze.
h. Packing: Graphite.
i. Port: Full.

2.3 IRON GATE VALVES

A. Iron Gate Valves, NRS, Class 150:

1. Description:

a. Standard: MSS SP-70, Type I.
b. CWP Rating: 200 psig.
c. Body Material: Gray iron with bolted bonnet.
d. Ends: Flanged.

e. Trim: Bronze.
f. Disc: Solid wedge.
g. Packing and Gasket: Asbestos free.

B. Iron Gate Valves, OS&Y, Class 125:

1. Description:

a. Standard: MSS SP-70, Type I.
b. CWP Rating: 200 psig.
c. Body Material: Gray iron with bolted bonnet.
d. Ends: Flanged.
e. Trim: Bronze.
f. Disc: Solid wedge.
g. Packing and Gasket: Asbestos free.

C. Iron Gate Valves, NRS, Class 250:

1. Description:

a. Standard: MSS SP-70, Type I.
b. CWP Rating: 500 psig.
c. Body Material: Gray iron with bolted bonnet.
d. Ends: Flanged.
e. Trim: Bronze.
f. Disc: Solid wedge.
g. Packing and Gasket: Asbestos free.

D. Iron Gate Valves, OS&Y, Class 250:

1. Description:

a. Standard: MSS SP-70, Type I.
b. CWP Rating: 500 psig.
c. Body Material: Gray iron with bolted bonnet.
d. Ends: Flanged.
e. Trim: Bronze.
f. Disc: Solid wedge.
g. Packing and Gasket: Asbestos free.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.

B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.

C. Examine threads on valve and mating pipe for form and cleanliness.

D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.

E. Do not attempt to repair defective valves; replace with new valves.

3.2 VALVE INSTALLATION

A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.

B. Locate valves for easy access and provide separate support where necessary.

C. Install valves in horizontal piping with stem at or above center of pipe.

D. Install valves in position to allow full stem movement.

E. Install valve tags. Comply with requirements in Section 220553 "Identification for Plumbing Piping and Equipment" for valve tags and schedules.

3.3 ADJUSTING

A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

3.4 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

A. Use gate valves for shutoff service only.

B. If valves with specified CWP ratings are unavailable, the same types of valves with higher CWP ratings may be substituted.

C. For Grooved-End Copper Tubing and Steel Piping: Valve ends may be grooved.

3.5 LOW-PRESSURE, COMPRESSED-AIR VALVE SCHEDULE 150 PSIG OR LESS

A. Pipe NPS 2 and Smaller: Bronze gate valves, NRS or RS, Class 125 with soldered or threaded ends.

3.6 HIGH-PRESSURE, COMPRESSED-AIR VALVE SCHEDULE 150 TO 200 PSIG

A. Pipe NPS 2 and Smaller: Bronze gate valves NRS or RS, Class 125 with soldered or threaded ends.

3.7 DOMESTIC HOT- AND COLD-WATER VALVE SCHEDULE

A. Pipe NPS 2 and Smaller:

1. Bronze gate valves, NRS or RS, Class 125 with soldered or threaded ends.

2. Bronze gate valves, press ends.

B. Pipe NPS 2-1/2 and Larger: Iron gate valves, NRS or OS&Y, Class 125 with flanged ends.

END OF SECTION 220523.15

SECTION 220529 - HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Metal pipe hangers and supports.
2. Trapeze pipe hangers.
3. Metal framing systems.
4. Thermal hanger-shield inserts.
5. Fastener systems.
6. Pipe stands.
7. Pipe-positioning systems.
8. Equipment supports.

B. Related Requirements:

1. Section 055000 "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
2. Section 220516 "Expansion Fittings and Loops for Plumbing Piping" for pipe guides and anchors.
3. Section 220548.13 "Vibration Controls for Plumbing Piping and Equipment" for vibration isolation devices.

1.3 ACTION SUBMITTALS

A. Shop Drawings: Show fabrication and installation details and include calculations for the following:

1. Trapeze pipe hangers.
2. Metal framing systems.
3. Pipe stands.
4. Equipment supports.

B. 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.

1. Detail fabrication and assembly of trapeze hangers.
2. Include design calculations for designing trapeze hangers.

1.4 INFORMATIONAL SUBMITTALS

A. Welding certificates.

1.5 QUALITY ASSURANCE

A. Structural-Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M.

B. Pipe Welding Qualifications: Qualify procedures and operators according to 2015 ASME Boiler and Pressure Vessel Code, Section IX.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design trapeze pipe hangers and equipment supports.

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, including pipe stands, 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.

2.2 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, hot-dip galvanized, or electro-galvanized.
3. Nonmetallic Coatings: Plastic coated or epoxy powder coated.
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 or stainless steel .

B. Stainless-Steel Pipe Hangers and Supports:

1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
2. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
3. Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel .

C. Copper Pipe and Tube 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 or stainless steel.

2.3 TRAPEZE PIPE HANGERS

A. Description: MSS SP-58, 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.

2.4 METAL FRAMING SYSTEMS

A. MFMA Manufacturer Metal Framing Systems:

1. Description: Shop- or field-fabricated pipe-support assembly, made of steel channels, accessories, fittings, and other components for supporting multiple parallel pipes.
2. Standard: Comply with MFMA-4, factory-fabricated components for field assembly.
3. Channels: Continuous slotted carbon-steel, stainless-steel, Type 304, stainless-steel, Type 316 or extruded-aluminum channel with inturned lips.
4. Channel Width: Selected for applicable load criteria.
5. Channel Nuts: Formed or stamped nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
6. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel or stainless steel.
7. Metallic Coating: Pregalvanized G90, Electroplated zinc or Hot-dip galvanized.
8. Paint Coating: Green epoxy, acrylic, or urethane.
9. Plastic Coating: PVC.

B. Non-MFMA Manufacturer Metal Framing Systems:

1. Description: Shop- or field-fabricated pipe-support assembly, made of steel channels, accessories, fittings, and other components for supporting multiple parallel pipes.
2. Standard: Comply with MFMA-4, factory-fabricated components for field assembly.
3. Channels: Continuous slotted carbon-steel or stainless-steel channel with inturned lips.
4. Channel Width: Select for applicable load criteria.
5. Channel Nuts: Formed or stamped nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
6. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel or stainless steel.
7. Metallic Coating: Pregalvanized G90 or Hot-dip galvanized
8. Paint Coating: Green epoxy, acrylic, or urethane.
9. Plastic Coating: PVC.

2.5 THERMAL HANGER-SHIELD INSERTS

A. Insulation-Insert Material for Cold Piping: ASTM C552, Type II cellular glass with 100-psig or ASTM C591, Type VI, Grade 1 polyisocyanurate with 125-psig minimum compressive strength and vapor barrier.

B. Insulation-Insert Material for Hot Piping: Water-repellent-treated, ASTM C533, Type I calcium silicate with 100-psig, ASTM C552, Type II cellular glass with 100-psig or ASTM C591, Type VI, Grade 1 polyisocyanurate with 125-psig minimum compressive strength.

C. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.

D. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.

E. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.6 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 anchors, for use in hardened portland cement concrete, with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

1. Indoor Applications: Zinc-coated or stainless steel.
2. Outdoor Applications: Stainless steel.

2.7 PIPE STANDS

A. General Requirements for Pipe Stands: Shop- or field-fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted piping.

B. Compact Pipe Stand:

1. Description: Single base unit with integral-rod roller, pipe clamps, or V-shaped cradle to support pipe, for roof installation without membrane penetration.
2. Base: Single, vulcanized rubber, molded polypropylene, or polycarbonate.
3. Hardware: Galvanized steel or polycarbonate.
4. Accessories: Protection pads.

C. Low-Profile, Single-Base, Single-Pipe Stand:

1. Description: Single base with vertical and horizontal members, and pipe support, for roof installation without membrane protection.
2. Base: Single, vulcanized rubber, molded polypropylene, or polycarbonate.
3. Vertical Members: Two galvanized or stainless-steel, continuous-thread, 1/2-inch rods.
4. Horizontal Member: Adjustable horizontal, galvanized or stainless-steel pipe support channels.
5. Pipe Supports: Roller, Strut clamps, Clevis hanger or Swivel hanger.
6. Hardware: Galvanized or Stainless steel.
7. Accessories: Protection pads.
8. Height: 12 inches above roof .

D. High-Profile, Single-Base, Single-Pipe Stand:

1. Description: Single base, vertical and horizontal members, and pipe support, for roof installation without membrane penetration.
2. Base: Single vulcanized rubber or molded polypropylene.
3. Vertical Members: Two galvanized or stainless-steel, continuous-thread, 1/2-inch rods.
4. Horizontal Member: One adjustable-height, galvanized or stainless-steel, pipe-support slotted channel or plate.

5. Pipe Supports: Roller, Clevis hanger or Swivel hanger.
6. Hardware: Galvanized or Stainless steel.
7. Accessories: Protection pads**,** 1/2-inch, continuous-thread, galvanized-steel rod or 1/2-inch, continuous-thread, stainless-steel rod.
8. Height: 36 inches above roof .

E. High-Profile, Multiple-Pipe Stand:

1. Description: Assembly of bases, vertical and horizontal members, and pipe supports, for roof installation without membrane penetration.
2. Bases: Two or more; vulcanized rubber or molded polypropylene.
3. Vertical Members: Two or more, galvanized or stainless-steel channels.
4. Horizontal Members: One or more, adjustable-height, galvanized or stainless-steel pipe support.
5. Pipe Supports: Roller, Strut clamps, Clevis hanger or Swivel hanger.
6. Hardware: Galvanized or Stainless steel.
7. Accessories: Protection pads**,** 1/2-inch, continuous-thread rod.
8. Height:36 inches above roof.

F. Curb-Mounted-Type Pipe Stands: Shop- or field-fabricated pipe supports made from structural-steel shapes, continuous-thread rods, and rollers, for mounting on permanent stationary roof curb.

2.8 PIPE-POSITIONING SYSTEMS

A. Description: IAPMO PS 42 positioning system composed of metal brackets, clips, and straps for positioning piping in pipe spaces; for plumbing fixtures in commercial applications.

2.9 EQUIPMENT SUPPORTS

A. Description: Welded, shop- or field-fabricated equipment support made from structural-carbon-steel shapes.

2.10 MATERIALS

A. Aluminum: ASTM B221.

B. Carbon Steel: ASTM A1011/A1011M.

C. Structural Steel: ASTM A36/A36M carbon-steel plates, shapes, and bars; black and galvanized.

D. Stainless Steel: ASTM A240/A240M.

E. Grout: ASTM C1107/C1107M, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.

1. Properties: Nonstaining, noncorrosive, and nongaseous.
2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 APPLICATION

A. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping materials and installation, for penetrations through fire-rated walls, ceilings, and assemblies.

B. Strength of Support Assemblies: Where not indicated, select sizes of components, so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb.

3.2 HANGER AND SUPPORT INSTALLATION

A. Metal Pipe-Hanger Installation: Comply with MSS SP-58. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.

B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-58. 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 A36/A36M carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.

C. Fiberglass Pipe-Hanger Installation: Comply with applicable portions of MSS SP-58. Install hangers and attachments as required to properly support piping from building structure.

D. Metal Framing System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled metal framing systems.

E. Thermal Hanger-Shield Installation: Install in pipe hanger or shield for insulated piping.

F. Fastener System Installation:

1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches thick in concrete, after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
2. Install mechanical-expansion anchors in concrete, after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.

G. Pipe Stand Installation:

1. Pipe Stand Types, except Curb-Mounted Type: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.
2. Curb-Mounted-Type Pipe Stands: Assemble components or fabricate pipe stand and mount on permanent, stationary roof curb. See Section 077200 "Roof Accessories" for curbs.

H. Pipe-Positioning-System Installation: Install support devices to make rigid supply and waste piping connections to each plumbing fixture.

I. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.

J. Equipment Support Installation: Fabricate from welded-structural-steel shapes.

K. 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.

L. Install lateral bracing with pipe hangers and supports to prevent swaying.

M. 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.

N. Load Distribution: Install hangers and supports, so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

O. 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.

P. Insulated Piping:

1. Attach clamps and spacers to piping.

   a. Piping Operating Above Ambient Air Temperature: Clamp may project through insulation.
   b. Piping Operating Below Ambient Air Temperature: Use thermal hanger-shield insert with clamp sized to match OD of insert.
   c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.

2. Install MSS SP-58, Type 39 protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.

   a. Option: Thermal hanger-shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.

3. Install MSS SP-58, Type 40 protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.

   a. Option: Thermal hanger-shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.

4. Shield Dimensions for Pipe: Not less than the following:

   a. NPS 1/5 to NPS 3: 12 inches long and 0.048 inch thick.
   b. NPS 4: 12 inches long and 0.06 inch thick.
   c. NPS 6: 18 inches long and 0.06 inch thick.
   d. NPS 8 to NPS 14: 24 inches long and 0.075 inch thick.

5. Pipes NPS 8 and Larger: Include wood or reinforced calcium-silicate-insulation inserts of length at least as long as protective shield.
6. Thermal Hanger Shields: Install with insulation of same thickness as piping insulation.

3.3 EQUIPMENT SUPPORTS

A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.

B. Grouting: Place grout under supports for equipment, and make bearing surface smooth.

C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.4 METAL FABRICATIONS

A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.

B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.

C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. Finish welds at exposed connections, so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

3.5 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 .

3.6 PAINTING

A. Touchup: Clean field welds and abraded, shop-painted areas. Paint exposed areas immediately after erecting hangers and supports. Use same materials as those 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.

B. Touchup: Cleaning and touchup painting of field welds, bolted connections, and abraded, shop-painted areas on miscellaneous metal are specified in Section 099113 "Exterior Painting.", Section 099123 "Interior Painting." or Section 099600 "High-Performance Coatings." Galvanized Surfaces: Clean welds, bolted connections, and abraded areas, and apply galvanizing-repair paint to comply with ASTM A780/A780M.

3.7 HANGER AND SUPPORT SCHEDULE

A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.

B. Comply with MSS SP-58 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 finishes.

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, metal trapeze pipe hangers and metal framing systems and attachments for general service applications.

F. Use stainless-steel pipe hangers and fiberglass pipe hangers and fiberglass strut systems and stainless-steel or corrosion-resistant attachments for hostile environment applications.

G. Use copper-plated pipe hangers and copper or stainless-steel attachments for copper piping and tubing.

H. Use padded hangers for piping that is subject to scratching.

I. Use thermal hanger-shield inserts for insulated piping and tubing.

J. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes NPS 1/2 to NPS 30.
2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of up to 1050 deg F pipes NPS 4 to NPS 24, requiring up to 4 inches of insulation.
3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes NPS 3/4 to NPS 36, requiring clamp flexibility and up to 4 inches of insulation.
4. 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 8.
10. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 8.
11. Extension Hinged or Two-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 or carbon-steel plate.
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 or carbon-steel plate, 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 two rods if longitudinal movement caused by expansion and contraction occurs.
18. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes NPS 2-1/2 to NPS 24, from single rod if horizontal movement caused by expansion and contraction occurs.
19. Complete Pipe Rolls (MSS Type 44): For support of pipes NPS 2 to NPS 42 if longitudinal movement caused by expansion and contraction occurs but vertical adjustment is unnecessary.
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 occurs and vertical adjustment is unnecessary.
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, in addition to expansion and contraction, is required.

K. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24.
2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 if longer ends are required for riser clamps.

L. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel Turnbuckles (MSS Type 13): For adjustment of 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.

M. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel or Malleable-Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction, to attach to top flange of structural shape.
3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
6. C-Clamps (MSS Type 23): For structural shapes.
7. 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.

N. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
3. Thermal Hanger-Shield Inserts: For supporting insulated pipe.

O. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. 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 allow 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 allow 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 allow 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.

P. Comply with MSS SP-58 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.

Q. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.

R. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.

S. Use pipe-positioning systems in pipe spaces behind plumbing fixtures to support supply and waste piping for plumbing fixtures.

END OF SECTION 220529

SECTION 220548.13 - VIBRATION CONTROLS FOR PLUMBING PIPING AND EQUIPMENT

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. Pipe-riser resilient support.
2. Resilient pipe guides.
3. Air-spring isolators.
4. Restrained-air-spring isolators.
5. Elastomeric hangers.
6. Spring hangers.
7. Snubbers.
8. Restraints - rigid type.
9. Restraints - cable type.
10. Restraint accessories.
11. Post-installed concrete anchors.
12. Concrete inserts.

B. Related Requirements:

1. Section 210548.13 "Vibration Controls for Fire-Suppression Piping and Equipment" for devices for fire-suppression equipment and systems.
2. Section 230548.13 "Vibration Controls for HVAC" for devices for HVAC equipment and systems.

1.3 DEFINITIONS

A. IBC: International Building Code.

B. OSHPD: Office of Statewide Health Planning and Development (for the State of California owned and regulated medical facilities).

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include rated load, rated deflection, and overload capacity for each vibration isolation device.

2. Include load rating for each wind-load-restraint fitting and assembly.
3. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of vibration isolation device component.

4. Annotate to indicate application of each product submitted and compliance with requirements.
5. Interlocking Snubbers: Include ratings for horizontal, vertical, and combined loads.

B. Delegated-Design Submittal:

1. For each wind-load protection device that is required by this Section or is indicated on Drawings, submit the following:
   a. Riser Supports: Include riser diagrams and calculations showing anticipated expansion and contraction at each support point, initial and final loads on building structure, and spring deflection changes. Include certification by professional engineer that riser system was examined for excessive stress and that none exists.
   b. Concrete Anchors and Inserts: Include calculations showing anticipated wind loads.
   c. All delegated-design submittals for wind-restraint detail Drawings are to be signed and sealed by qualified professional engineer responsible for their preparation.
   d. Product Listing, Preapproval, and Evaluation Documentation: By an agency acceptable to authorities having jurisdiction, showing maximum ratings of restraint items and basis for approval (tests or calculations).
2. Riser Supports: Include riser diagrams and calculations showing anticipated expansion and contraction at each support point, initial and final loads on building structure, and spring deflection changes. Include certification that riser system was examined for excessive stress and that none exists.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Show coordination of vibration isolation device installation for plumbing piping and equipment with other systems and equipment in the vicinity, including other supports and restraints, if any.

B. Qualification Data: For professional engineer and testing agency.

C. Welding certificates.

D. Air-Spring Mounting System Performance Certification: Include natural frequency, load, and damping test data performed by an independent agency.

E. Field quality-control reports.

1.6 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct testing indicated, be an NRTL as defined by OSHA in 29 CFR 1910.7 and be acceptable to authorities having jurisdiction.

B. Welding Qualifications: Qualify procedures and personnel in accordance with AWS D1.1/D1.1M, "Structural Welding Code - Steel."

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design system.

1. Wind-Load Performance: Equipment and systems shall withstand the effects of high wind events determined in accordance with ASCE/SEI 7-05, ASCE/SEI 7-10 or ASCE/SEI 7-16.

B. Consequential Damage: Provide additional restraints for suspended fire-suppression system components or anchorage of floor-, roof-, or wall-mounted fire-suppression system components as indicated in ASCE/SEI 7-05, ASCE/SEI 7-10 or ASCE/SEI 7-16 so that failure of a non-essential or essential fire-suppression system component will not cause failure of any other essential architectural, mechanical, or electrical building component.

C. Fire/Smoke Resistance: All components that are not constructed of ferrous metals must have a maximum flame-spread index of 25 and maximum smoke-developed index of 50 when tested by an NRTL in accordance with ASTM E84 or UL 723, and be so labeled.

D. Component Supports:

1. Load ratings, features, and applications of all reinforcement components must be based on testing standards of a nationally recognized testing agency.
2. All component support attachments must comply with force and displacement resistance requirements of ASCE/SEI 7-05 Section 13.6, ASCE/SEI 7-10 Section 13.6 or ASCE/SEI 7-16 Section 13.6.

2.2 PIPE-RISER RESILIENT SUPPORT

A. All-Directional, Acoustical Pipe Anchor Consisting of Two Steel Tubes Separated by a Minimum 1/2-inch Thick Neoprene:

1. Vertical-Limit Stops: Steel and neoprene vertical-limit stops arranged to prevent vertical travel in both directions.
2. Maximum Load Per Support: 500 psi on isolation material providing equal isolation in all directions.
3. Minimum deflection as indicated on Drawings.

2.3 RESILIENT PIPE GUIDES

A. Telescopic Arrangement of Two Steel Tubes or Post and Sleeve Arrangement Separated by a Minimum 1/2-inch Thick Neoprene:

1. Factory-Set Height Guide with Shear Pin: Shear pin shall be removable and reinsertable to allow for selection of pipe movement. Guides shall be capable of motion to meet location requirements.

2.4 AIR-SPRING ISOLATORS

A. Freestanding, Single or Multiple, Compressed-Air Bellows:

1. Bellows Assembly: Upper and lower powder-coated steel sections connected by a replaceable, flexible, nylon-reinforced neoprene bellows or similar elastomeric material.
2. Maximum Natural Frequency: 3 Hz.
3. Operating Pressure Range: 25 to 100 psi.
4. Burst Pressure: At least three times manufacturer's published maximum operating pressure.
5. Minimum deflection as indicated on Drawings.
6. Automatic leveling valve.

2.5 RESTRAINED-AIR-SPRING ISOLATORS

A. Freestanding, Single or Multiple, Compressed-Air Bellows with Vertical-Limit Stop Restraint:

1. Housing: Steel housing with vertical-limit stops to prevent spring extension due to weight being removed.

    a. Base with holes for bolting to structure with an elastomeric isolator pad attached to the underside. Bases shall limit floor load to 500 psi.
    b. Top plate with threaded mounting holes or elastomeric pad.
    c. Internal leveling bolt that acts as blocking during installation.

2. Restraint: Limit stop as required for equipment and authorities having jurisdiction.
3. Minimum deflection as indicated on Drawings.
4. Minimum Additional Travel: 50 percent of the required deflection at rated load.
5. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
6. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
7. Bellows Assembly: Upper and lower powder-coated steel sections connected by a replaceable, flexible, nylon-reinforced neoprene bellows or similar elastomeric material.
8. Maximum Natural Frequency: 3 Hz.
9. Operating Pressure Range: 25 to 100 psi.
10. Burst Pressure: At least three times manufacturer's published maximum operating pressure.
11. Automatic leveling valve.

2.6 ELASTOMERIC HANGERS

A. Elastomeric Mount in a Steel Frame with Upper and Lower Steel Hanger Rods:

1. Frame: Steel, fabricated with a connection for an upper threaded hanger rod and an opening on the underside to allow for a maximum of 30 degrees of angular lower hanger-rod misalignment without binding or reducing isolation efficiency.
2. Damping Element: Molded, oil-resistant rubber, neoprene, or other elastomeric material with a projecting bushing for the underside opening preventing steel-to-steel contact.
3. Minimum deflection as indicated on Drawings.

2.7 SPRING HANGERS

A. Combination Coil-Spring and Elastomeric-Insert Hanger with Spring and Insert in Compression:

1. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.
2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
5. Minimum deflection as indicated on Drawings.
6. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
7. Elastomeric Element: Molded, oil-resistant rubber or neoprene. Steel-washer-reinforced cup to support spring and bushing projecting through bottom of frame.
8. Adjustable Vertical Stop: Steel washer with neoprene washer "up-stop" on lower threaded rod.
9. Self-centering hanger rod cap to ensure concentricity between hanger rod and support spring coil.

2.8 SNUBBERS

A. Description: Factory fabricated using welded structural-steel shapes and plates, anchor bolts, and replaceable resilient isolation washers and bushings.

1. Post-Installed Concrete Anchor Bolts: Secure to concrete surface with post-installed concrete anchors. Anchors to be prequalified in accordance with ACI 355.2 testing and designated in accordance with ACI 318-11 Appendix D for 2012 IBC
2. Preset Concrete Inserts: Prequalified in accordance with ICC-ES AC446 testing.
3. Anchors in Masonry: Design in accordance with TMS 402.
4. Resilient Isolation Washers and Bushings: Oil- and water-resistant neoprene.
5. Resilient Cushion: Maximum 1/4-inch air gap, and minimum 1/4 inch thick.

2.9 RESTRAINTS - RIGID TYPE

A. Description: Shop- or field-fabricated bracing assembly made of AISI S110-07-S1 slotted steel channels, ANSI/ASTM A53/A53M steel pipe as per NFPA 13, or other rigid steel brace member. Includes accessories for attachment to braced component at one end and to building structure at the other end and other matching components and with corrosion-resistant coating; rated in tension, compression, and torsion forces.

2.10 RESTRAINTS - CABLE TYPE

A. Restraint Cables: ASTM A1023/A1023M galvanized or ASTM A603 galvanized-steel or ASTM A492 stainless steel cables. End connections made of steel assemblies with thimbles, brackets, swivel, and bolts designed for restraining cable service; with fittings attached by means of poured socket, swaged socket, or mechanical (Flemish eye) loop.

B. Restraint cable assembly and cable fittings must comply with ASCE/SEI 19-16. All cable fittings and complete cable assembly must maintain the minimum cable breaking force. U-shaped cable clips and wedge-type end fittings do not comply and are unacceptable.

2.11 RESTRAINT ACCESSORIES

A. Hanger-Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections or Reinforcing steel angle clamped to hanger rod.

B. Hinged and Swivel Brace Attachments: Multifunctional steel connectors for attaching hangers to rigid channel bracings and restraint cables.

C. Bushings for Floor-Mounted Equipment Anchor Bolts: Neoprene bushings designed for rigid equipment mountings, and matched to type and size of anchor bolts and studs.

D. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for rigid equipment mountings, and matched to type and size of attachment devices used.

E. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.

2.12 POST-INSTALLED CONCRETE ANCHORS

A. Mechanical Anchor Bolts:

1. Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E488/E488M.

B. Adhesive Anchor Bolts:

1. Drilled-in and capsule anchor system containing PVC or urethane methacrylate-based resin and accelerator, or injected polymer or hybrid mortar adhesive. Provide anchor bolts and hardware with zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E488/E488M.

C. Provide post-installed concrete anchors that have been prequalified for use in wind-load applications. Post-installed concrete anchors must comply with all requirements of ASCE/SEI 7-16, Ch. 13.

1. Prequalify post-installed anchors in concrete in accordance with ACI 355.2 or other approved qualification testing procedures.
2. Prequalify post-installed anchors in masonry in accordance with approved qualification procedures.

2.13 CONCRETE INSERTS

A. Provide preset concrete inserts that are prequalified in accordance with ICC-ES AC466 testing.

B. Comply with ANSI/MSS SP-58.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and equipment to receive vibration isolation devices for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.

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

3.2 APPLICATIONS

A. Multiple Pipe Supports: Secure pipes to trapeze member with clamps approved for application by an agency acceptable to authorities having jurisdiction.

B. Hanger-Rod Stiffeners: Install where indicated or scheduled on Drawings to receive them and where required to prevent buckling of hanger rods due to wind load forces.

C. Strength of Support Assemblies: Where not indicated, select sizes of components so strength is adequate to carry static forces within specified loading limits.

3.3 INSTALLATION OF VIBRATION-CONTROL DEVICES

A. Provide vibration-control devices for systems and equipment where indicated in Equipment Schedules or Vibration-Control Device Schedules, where indicated on Drawings, or where the Specifications indicate they are to be installed on specific equipment and systems.

B. Provide wind-load control devices for systems and equipment where indicated in Equipment Schedules or Vibration-Control Device Schedules, where indicated on Drawings, where the Specifications indicate they are to be installed on specific equipment and systems, and where required by applicable codes.

C. Coordinate location of embedded connection hardware with supported equipment attachment and mounting points and with requirements for concrete reinforcement and formwork specified in Section 033000 "Cast-in-Place Concrete."

D. Installation of vibration isolators must not cause any stresses, misalignment or change of position of equipment or piping.

E. Comply with requirements in Section 077200 "Roof Accessories" for installation of roof curbs, equipment supports, and roof penetrations.

F. Equipment Restraints:

1. Install snubbers on plumbing equipment mounted on vibration isolators. Locate snubbers as close as possible to vibration isolators and bolt to equipment base and supporting structure.
2. Install resilient bolt isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch.

3. Install wind-load-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction that provides required submittals for component.

G. Piping Restraints:

1. Comply with requirements in MSS SP-127.
2. Space lateral supports a maximum of 40 feet o.c., and longitudinal supports a maximum of 80 feet o.c.
3. Brace a change of direction longer than 12 feet.

H. Install wind-load-restraint cables so they do not bend across edges of adjacent equipment or building structure.

I. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.

J. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.

K. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.

L. Post-Installed Concrete Anchors:

1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify Project structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
3. Mechanical-Type Anchor Bolts: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
4. Adhesive-Type Anchor Bolts: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.
5. Set anchors to manufacturer's recommended torque, using a torque wrench.
6. Install zinc-coated steel anchors for interior and stainless steel anchors for exterior applications.

3.4 ACCOMMODATION OF DIFFERENTIAL MOTION

A. Provide flexible connections in piping systems where they cross structural joints and other point where differential movement may occur. Provide adequate flexibility to accommodate differential movement as determined in accordance with ASCE/SEI 7. Comply with requirements in Section 221116 "Domestic Water Piping" and Section 221119 "Domestic Water Piping Specialties" for piping flexible connections.

3.5 ADJUSTING

A. Adjust isolators after system is at operating weight.

B. Adjust limit stops on restrained-spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.

3.6 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

C. Tests and Inspections:
1. Perform tests and inspections.
2. Provide evidence of recent calibration of test equipment by a testing agency acceptable to authorities having jurisdiction.
3. Schedule test with Owner, through Architect, before connecting anchorage device to restrained component (unless postconnection testing has been approved), and with at least seven days' advance notice.
4. Obtain Architect's approval before transmitting test loads to structure. Provide temporary load-spreading members.
5. Test no fewer than four of each type and size of installed anchors and fasteners selected by Architect.
6. Test to 90 percent of rated proof load of device.
7. Measure isolator restraint clearance.
8. Measure isolator deflection.
9. Verify snubber minimum clearances.
10. Test and adjust restrained-air-spring isolator controls and safeties.

D. Remove and replace malfunctioning units and retest as specified above.

A. Units will be considered defective if they do not pass tests and inspections.

B. Prepare test and inspection reports.

END OF SECTION 220548.13

SECTION 220553 - IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

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. Equipment labels.
2. Warning signs and labels.
3. Pipe labels.
4. Stencils.
5. Valve tags.
6. Warning tags.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Samples: For color, letter style, and graphic representation required for each identification material and device.

C. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.

D. Valve numbering scheme.

E. Valve Schedules: For each piping system to include in maintenance manuals.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

A. Metal Labels for Equipment:

1. Material and Thickness: Brass, 0.032-inch, stainless steel, 0.025-inch, aluminum, 0.032-inch or anodized aluminum, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
2. Letter Color: Black.
3. Background Color: White.
4. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

5. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.
6. Fasteners: Stainless-steel rivets or self-tapping screws.
7. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), and the Specification Section number and title where equipment is specified.

C. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch bond paper. Tabulate equipment identification number, and identify Drawing numbers where equipment is indicated (plans, details, and schedules) and the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.2 WARNING SIGNS AND LABELS

A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.

B. Letter Color: Black.

C. Background Color: Yellow.

D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.

E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

F. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.

G. Fasteners: Stainless-steel rivets or self-tapping screws.

H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

I. Label Content: Include caution and warning information plus emergency notification instructions.

2.3 PIPE LABELS

A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.

B. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.

C. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.

D. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings; also include pipe size and an arrow indicating flow direction.

1. Flow-Direction Arrows: Integral with piping-system service lettering to accommodate both directions or as separate unit on each pipe label to indicate flow direction.
2. Lettering Size: At least 1/2 inch for viewing distances up to 72 inches and proportionately larger lettering for greater viewing distances.

2.4 STENCILS

A. Stencils for Piping:

1. Lettering Size: At least 1/2 inch for viewing distances up to 72 inches and proportionately larger lettering for greater viewing distances.
2. Stencil Material: Aluminum or Brass.
3. Stencil Paint: Exterior, gloss, alkyd enamel or acrylic enamel in colors complying with recommendations in ASME A13.1 unless otherwise indicated. Paint may be in pressurized spray-can form.
4. Identification Paint: Exterior, alkyd enamel or acrylic enamel in colors according to ASME A13.1 unless otherwise indicated. Paint may be in pressurized spray-can form.

2.5 VALVE TAGS

A. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers.

1. Tag Material: Brass, 0.032-inch, stainless steel, 0.025-inch, aluminum, 0.032-inch or anodized aluminum, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
2. Fasteners: Brass wire-link chain or beaded chain or S-hook.

B. Valve Schedules: For each piping system, on 8-1/2-by-11-inch bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.

1. Valve-tag schedule shall be included in operation and maintenance data.

2.6 WARNING TAGS

A. Description: Preprinted or partially preprinted accident-prevention tags of plasticized card stock with matte finish suitable for writing.

1. Size: 3 by 5-1/4 inches minimum.
2. Fasteners: Brass grommet and wire or Reinforced grommet and wire.
3. Nomenclature: Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT OPERATE."
4. Color: Safety yellow background with black lettering.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 GENERAL INSTALLATION REQUIREMENTS

A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

B. Coordinate installation of identifying devices with locations of access panels and doors.

C. Install identifying devices before installing acoustical ceilings and similar concealment.

3.3 EQUIPMENT LABEL INSTALLATION

A. Install or permanently fasten labels on each major item of mechanical equipment.

B. Locate equipment labels where accessible and visible.

3.4 PIPE LABEL INSTALLATION

A. Piping Color Coding: Painting of piping is specified in Section 099123 "Interior Painting." or Section 099600 "High-Performance Coatings."

B. Stenciled Pipe Label Option: Stenciled labels may be provided instead of manufactured pipe labels, at Installer's option. Install stenciled pipe labels, complying with ASME A13.1, with painted, color-coded bands or rectangles on each piping system.

1. Identification Paint: Use for contrasting background.
2. Stencil Paint: Use for pipe marking.

C. Pipe Label Locations: Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:

1. Near each valve and control device.
2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
4. At access doors, manholes, and similar access points that permit view of concealed piping.
5. Near major equipment items and other points of origination and termination.
6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.

D. Directional Flow Arrows: Arrows shall be used to indicate direction of flow in pipes, including pipes where flow is allowed in both directions.

E. Pipe Label Color Schedule:

1. Low-Pressure Compressed Air Piping:

a. Background: Safety blue.
b. Letter Colors: White.

2. High-Pressure Compressed Air Piping:

a. Background: Safety blue.
b. Letter Colors: White.

3. Domestic Water Piping

a. Background: Safety green.
b. Letter Colors: White.

4. Sanitary Waste and Storm Drainage Piping:

a. Background Color: Safety white .
b. Letter Color: Black .

3.5 VALVE-TAG INSTALLATION

A. Install tags on valves and control devices in piping systems, except check valves, valves within factory-fabricated equipment units, shutoff valves, faucets, convenience and lawn-watering hose connections, and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.

B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in the following subparagraphs:

1. Valve-Tag Size and Shape:

a. Cold Water: 1-1/2 inches round.
b. Hot Water: 1-1/2 inches round.
c. Low-Pressure Compressed Air: 1-1/2 inches round.
d. High-Pressure Compressed Air: 1-1/2 inches round.

2. Valve-Tag Colors:

a. Cold Water: Natural.
b. Hot Water: Natural.
c. Low-Pressure Compressed Air: Natural.
d. High-Pressure Compressed Air: Natural.

3. Letter Colors:

a. Cold Water: White.
b. Hot Water: White.
c. Low-Pressure Compressed Air: White.

d. High-Pressure Compressed Air: White.

3.6 WARNING-TAG INSTALLATION

A. Write required message on, and attach warning tags to, equipment and other items where required.

END OF SECTION 220553

SECTION 220719 - PLUMBING PIPING INSULATION

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 insulating the following plumbing piping services:

1. Domestic cold-water piping.
2. Domestic hot-water piping.
3. Domestic recirculating hot-water piping.
4. Sanitary waste piping exposed to freezing conditions.
5. Storm-water piping exposed to freezing conditions.
6. Roof drains and rainwater leaders.
7. Supplies and drains for handicap-accessible lavatories and sinks.

B. Related Sections:

1. Section 220716 "Plumbing Equipment Insulation" for equipment insulation.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory and field applied if any).

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

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.

C. Samples: For each type of insulation and jacket indicated. Identify each Sample, describing product and intended use. Sample sizes are as follows:

1. Preformed Pipe Insulation Materials: 12 inches long by NPS 2.
2. Jacket Materials for Pipe: 12 inches long by NPS 2.
3. Sheet Jacket Materials: 12 inches square.

4. Manufacturer's Color Charts: For products where color is specified, show the full range of colors available for each type of finish material.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer.

B. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.

C. Field quality-control reports.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.

B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products in accordance with ASTM E84 by a testing 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 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.

C. Mockups: Before installing insulation, build mockups for each type of insulation and finish listed below to demonstrate quality of insulation application and finishes. Build mockups in the location indicated or, if not indicated, as directed by Architect. Use materials indicated for the completed Work.

1. Piping Mockups:

a. One 10-foot section of NPS 2 straight pipe.
b. One each of a 90 degree threaded, welded, and flanged elbow.
c. One each of a threaded, welded, and flanged tee fitting.
d. One NPS 2 or smaller valve and one NPS 2-1/2 or larger valve.
e. Four support hangers, including hanger shield and insert.
f. One threaded strainer and one flanged strainer with removable portion of insulation.
g. One threaded reducer and one welded reducer.
h. One pressure temperature tap.
i. One mechanical coupling.
j. One union.

2. For each mockup, fabricate cutaway sections to allow observation of application details for insulation materials, adhesives, mastics, attachments, and jackets.
3. Notify Architect seven days in advance of dates and times when mockups will be constructed.

4. Obtain Architect's approval of mockups before starting insulation application.
5. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
6. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
7. Demolish and remove mockups when directed.

D. Comply with the following applicable standards and other requirements specified for miscellaneous components:

1. Supply and Drain Protective Shielding Guards: ICC A117.1.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.7 COORDINATION

A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."

B. Coordinate clearance requirements with piping Installer for piping insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

C. Coordinate installation and testing of heat tracing.

1.8 SCHEDULING

A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.

B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

A. Comply with requirements in "Piping Insulation Schedule, General," "Indoor Piping Insulation Schedule," "Outdoor, Aboveground Piping Insulation Schedule," and "Outdoor, Underground Piping Insulation Schedule" articles for where insulating materials shall be applied.

B. Products shall not contain asbestos, lead, mercury, or mercury compounds.

C. Products that come into contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested in accordance with ASTM C871.

D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable in accordance with ASTM C795.

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. Comply with ASTM C552.

1. Preformed Pipe Insulation: Type II, Class 1, without jacket.
2. Preformed Pipe Insulation: Type II, Class 2, with factory-applied ASJ-SSL jacket.
3. Factory fabricate shapes in accordance with ASTM C450 and ASTM C585.
4. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

G. Flexible Elastomeric: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C534/C534M, Type I for tubular materials.

H. Mineral-Fiber, Preformed Pipe: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C547.

1. Preformed Pipe Insulation: Type I, Grade A**,** without factory-applied jacket.
2. 850 deg F.
3. Factory fabricate shapes in accordance with ASTM C450 and ASTM C585.
4. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

I. Phenolic: Preformed pipe insulation of rigid, expanded, closed-cell structure. Comply with ASTM C1126.

1. Preformed Pipe Insulation: Type III**,** without factory-applied jacket.
2. Factory fabricate shapes in accordance with ASTM C450 and ASTM C585.
3. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

J. Polyolefin: Unicellular, polyethylene thermal plastic insulation. Comply with ASTM C534/C534M or ASTM C1427, Type I, Grade 1, for tubular materials.

2.2 INSULATING CEMENTS

A. Mineral-Fiber Insulating Cement: Comply with ASTM C195.

B. Expanded or Exfoliated Vermiculite Insulating Cement: Comply with ASTM C196.

C. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C449.

2.3 ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.

B. Cellular-Glass Adhesive: Two-component, thermosetting urethane adhesive containing no flammable solvents, with a service temperature range of minus 100 to plus 200 deg F.

C. Flexible Elastomeric and Polyolefin Adhesive: Solvent-based adhesive.

1. Flame-spread index shall be 25 or less and smoke-developed index shall be 50 or less as tested in accordance with ASTM E84.

2. Wet Flash Point: Below 0 deg F.
3. Service Temperature Range: 40 to 200 deg F.
4. Color: Black.

D. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

E. Phenolic Adhesive: Solvent-based resin adhesive, with a service temperature range of minus 75 to plus 300 deg F.

F. ASJ Adhesive and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A, for bonding insulation jacket lap seams and joints.

G. PVC Jacket Adhesive: Compatible with PVC jacket.

2.4 MASTICS AND COATINGS

A. Materials shall be compatible with insulation materials, jackets, and substrates.

B. Vapor-Retarder Mastic, Water Based: Suitable for indoor use on below-ambient services.

1. Water-Vapor Permeance: Comply with ASTM E96/E96M or ASTM F1249.
2. Service Temperature Range: 0 to plus 180 deg F.
3. Comply with MIL-PRF-19565C, Type II, for permeance requirements**,** with supplier listing on DOD QPD - Qualified Products Database.
4. Color: White.

C. Vapor-Retarder Mastic, Solvent Based, Indoor Use: Suitable for indoor use on below-ambient services.

1. Water-Vapor Permeance: Comply with ASTM E96/E96M or ASTM F1249.
2. Service Temperature Range: 0 to 180 deg F.
3. Color: White.

D. Vapor-Retarder Mastic, Solvent Based, Outdoor Use: Suitable for outdoor use on below-ambient services.

1. Water-Vapor Permeance: Comply with ASTM E96/E96M or ASTM F1249.
2. Service Temperature Range: Minus 50 to plus 220 deg F.
3. Color: White.

E. Breather Mastic: Water based; suitable for indoor and outdoor use on above-ambient services.

1. Water-Vapor Permeance: ASTM E96/E96M, greater than 1.0 perm at manufacturer's recommended dry film thickness.
2. Service Temperature Range: 0 to plus 180 deg F.
3. Color: White.

2.5 LAGGING ADHESIVES

A. Adhesives shall comply with MIL-A-3316C, Class I, Grade A, and shall be compatible with insulation materials, jackets, and substrates.

1. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over pipe insulation.
2. Service Temperature Range: 20 to plus 180 deg F.
3. Color: White.

2.6 SEALANTS

A. Materials shall be as recommended by the insulation manufacturer and shall be compatible with insulation materials, jackets, and substrates.

B. Joint Sealants:

1. Permanently flexible, elastomeric sealant.
2. Service Temperature Range: Minus 58 to plus 176 deg F.
3. Color: White or gray.

C. FSK and Metal Jacket Flashing Sealants:

1. Fire- and water-resistant, flexible, elastomeric sealant.
2. Service Temperature Range: Minus 40 to plus 250 deg F.
3. Color: Aluminum.

D. ASJ Flashing Sealants and PVC Jacket Flashing Sealants:

1. Fire- and water-resistant, flexible, elastomeric sealant.
2. Service Temperature Range: Minus 40 to plus 250 deg F.
3. Color: White.

2.7 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 C1136, Type I.
2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C1136, Type I.
3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C1136, Type II.

2.8 FIELD-APPLIED FABRIC-REINFORCING MESH

A. Woven Glass-Fiber Fabric: Approximately 2 oz./sq. yd. with a thread count of 10 strands by 10 strands/sq. in. for covering pipe and pipe fittings.

B. Woven Polyester Fabric: Approximately 1 oz./sq. yd. with a thread count of 10 strands by 10 strands/sq. in., in a Leno weave, for pipe.

2.9 FIELD-APPLIED CLOTHS

A. Woven Glass-Fiber Fabric: Comply with MIL-C-20079H, Type I, plain weave, and presized a minimum of 8 oz./sq. yd.

2.10 FIELD-APPLIED JACKETS

A. Field-applied jackets shall comply with ASTM C1136, Type I, unless otherwise indicated.

B. FSK Jacket: Aluminum-foil-face, fiberglass-reinforced scrim with kraft-paper backing.

C. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D1784, 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. Adhesive: As recommended by jacket material manufacturer.
2. Color: White.
3. 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.

D. Metal Jacket:

1. Aluminum Jacket: Comply with ASTM B209, Alloy 3003, 3005, 3105, or 5005, Temper H-14.

a. Factory cut and rolled to size.
b. Finish and thickness are indicated in field-applied jacket schedules.
c. Moisture Barrier for Indoor Applications: 3-mil thick, heat-bonded polyethylene and kraft paper.
d. Moisture Barrier for Outdoor Applications: 3-mil thick, heat-bonded polyethylene and kraft paper.
e. Factory-Fabricated Fitting Covers:

1) Same material, finish, and thickness as jacket.
2) Preformed two-piece or gore, 45- and 90-degree, short- and long-radius elbows.
3) Tee covers.
4) Flange and union covers.
5) End caps.
6) Beveled collars.
7) Valve covers.
8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

2. Stainless-Steel Jacket: ASTM A240/A240M.

a. Factory cut and rolled to size.
b. Material, finish, and thickness are indicated in field-applied jacket schedules.
c. Moisture Barrier for Indoor Applications: 3-mil thick, heat-bonded polyethylene and kraft paper.
d. Moisture Barrier for Outdoor Applications: 3-mil thick, heat-bonded polyethylene and kraft paper.
e. Factory-Fabricated Fitting Covers:

1) Same material, finish, and thickness as jacket.
2) Preformed two-piece or gore, 45- and 90-degree, short- and long-radius elbows.
3) Tee covers.
4) Flange and union covers.
5) End caps.
6) Beveled collars.
7) Valve covers.
8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

E. Underground Direct-Buried Jacket: 125-mil thick vapor barrier and waterproofing membrane, consisting of a rubberized bituminous resin reinforced with a woven-glass fiber or polyester scrim and laminated aluminum foil.

F. Self-Adhesive Outdoor Jacket: 60-mil thick, laminated vapor barrier and waterproofing membrane for installation over insulation located aboveground outdoors; consisting of a rubberized bituminous resin on a cross-laminated polyethylene film covered with [**white**] [**stucco-embossed**] aluminum-foil facing.

2.11 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C1136.
1. Width: 3 inches.
2. Thickness: 11.5 mils.
3. Adhesion: 90 ounces force/inch in width.
4. Elongation: 2 percent.
5. Tensile Strength: 40 lbf/inch in width.
6. 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 C1136.
1. Width: 3 inches.
2. Thickness: 6.5 mils.
3. Adhesion: 90 ounces force/inch in width.
4. Elongation: 2 percent.
5. Tensile Strength: 40 lbf/inch in width.
6. 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. Width: 2 inches.
2. Thickness: 6 mils.
3. Adhesion: 64 ounces force/inch in width.
4. Elongation: 500 percent.
5. Tensile Strength: 18 lbf/inch in width.

D. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.
1. Width: 2 inches.
2. Thickness: 3.7 mils.
3. Adhesion: 100 ounces force/inch in width.
4. Elongation: 5 percent.
5. Tensile Strength: 34 lbf/inch in width.

2.12 SECUREMENTS

A. Bands:
1. Stainless Steel: ASTM A240/A240M, Type 304 or Type 316; 0.015 inch thick, 3/4 inch wide with wing seal or closed seal.
2. Aluminum: ASTM B209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 3/4 inch wide with wing seal or closed seal.

B. Staples: Outward-clinching insulation staples, nominal 3/4-inch wide, stainless steel or Monel.

C. Wire: 0.080-inch nickel-copper alloy, 0.062-inch soft-annealed, stainless steel or 0.062-inch soft-annealed, galvanized steel.

2.13 PROTECTIVE SHIELDING GUARDS

A. Protective Shielding Pipe Covers:

1. Description: Manufactured plastic wraps for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with Americans with Disabilities Act (ADA) requirements.

B. Protective Shielding Piping Enclosures:

1. Description: Manufactured plastic enclosure for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with ADA requirements.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.

1. Verify that systems to be insulated have been tested and are free of defects.
2. Verify that surfaces to be insulated are clean and dry.

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

3.2 PREPARATION

A. Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

B. Clean and prepare surfaces to be insulated. Before insulating, apply a corrosion coating to insulated surfaces as follows:

1. Stainless Steel: Coat 300 series stainless steel with an epoxy primer 5 mils thick and an epoxy finish 5 mils thick if operating in a temperature range of between 140 and 300 deg F. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
2. Carbon Steel: Coat carbon steel operating at a service temperature of between 32 and 300 deg F with an epoxy coating. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.

C. Coordinate insulation installation with the tradesman installing heat tracing. Comply with requirements for heat tracing that apply to insulation.

D. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless steel surfaces, use demineralized water.

3.3 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping, including fittings, valves, and specialties.

B. Install insulation materials, forms, vapor barriers or retarders, jackets, and of thicknesses required for each item of 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 storage, application, and finishing. Replace insulation materials that get wet.

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 attached to structure with vapor-barrier mastic.
3. Install insert materials and insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.

K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

L. Install insulation with factory-applied jackets as follows:

1. Draw jacket tight and smooth.
2. Cover circumferential joints with 3-inch wide strips, of same material as insulation jacket. Secure strips with adhesive and outward-clinching staples along both edges of strip, spaced 4 inches o.c.
3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward-clinching staples along edge at 4 inches o.c.

a. For below-ambient services, apply vapor-barrier mastic over staples.

4. Cover joints and seams with tape, in accordance with insulation material manufacturer's written instructions, 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 25 percent of its nominal thickness.

N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches in similar fashion 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. Cleanouts.

3.4 PENETRATIONS

A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.

1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
4. Seal jacket to roof flashing with flashing sealant.

B. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.

C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.

1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
4. Seal jacket to wall flashing with flashing sealant.

D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

E. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.

1. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping and fire-resistive joint sealers.

F. Insulation Installation at Floor Penetrations:

1. Pipe: Install insulation continuously through floor penetrations.
2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

3.5 GENERAL PIPE INSULATION INSTALLATION

A. Requirements in this article generally apply to all insulation materials, except where more specific requirements are specified in various pipe insulation material installation articles.

B. Insulation Installation on Fittings, Valves, Strainers, Flanges, Mechanical Couplings, and Unions:

1. Install insulation over fittings, valves, strainers, flanges, mechanical couplings, 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 that of 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 that 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 that used for adjacent pipe. Overlap adjoining pipe insulation by not less than 2 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 2 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, mechanical couplings, and unions, using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than 2 times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Stencil or label the outside insulation jacket of each union with the word "union" matching size and color of pipe labels.
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.

C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes. 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 that of adjoining pipe insulation.
2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union at least 2 times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless steel or aluminum bands. Select band material compatible with insulation and jacket.
3. Construct removable valve insulation covers in same manner as for flanges, except divide the two-part section on the vertical center line of valve body.
4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

3.6 INSTALLATION OF CELLULAR-GLASS INSULATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of insulation to pipe with wire or bands, and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above-ambient services, secure laps with outward-clinched staples at 6 inches o.c.
4. For insulation with factory-applied jackets on below-ambient services, do not staple longitudinal tabs. Instead, 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 that of pipe insulation.

4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as that of 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.

3.7 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

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 that of 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 that of pipe insulation when available.
2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.
4. Secure insulation to valves and specialties, and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.8 INSTALLATION OF MINERAL-FIBER INSULATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of preformed pipe insulation to pipe with wire or bands, and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above-ambient surfaces, secure laps with outward-clinched staples at 6 inches o.c.
4. For insulation with factory-applied jackets on below-ambient surfaces, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive, as recommended by insulation material manufacturer, and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as that of straight segments of pipe insulation when available.
2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of same material as that of straight segments of pipe insulation when available.
2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
4. Install insulation to flanges as specified for flange insulation application.

3.9 INSTALLATION OF PHENOLIC INSULATION

A. General Installation Requirements:

1. Secure single-layer insulation with stainless steel bands at 12-inch intervals, and tighten bands without deforming insulation materials.
2. Install two-layer insulation with joints tightly butted and staggered at least 3 inches. Secure inner layer with 0.062-inch wire spaced at 12-inch intervals. Secure outer layer with stainless steel bands at 12-inch intervals.

B. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of insulation to pipe with wire or bands, and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above-ambient services, secure laps with outward-clinched staples at 6 inches o.c.
4. For insulation with factory-applied jackets with vapor retarders on below-ambient services, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive, as recommended by insulation material manufacturer, and seal with vapor-barrier mastic and flashing sealant.

C. 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 block insulation of same material and thickness as that of pipe insulation.

D. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed insulation sections of same material as that of straight segments of pipe insulation. Secure according to manufacturer's written instructions.

E. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed insulation sections of same material as that of straight segments of pipe insulation. Secure according to manufacturer's written instructions.
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.

3.10 INSTALLATION OF POLYOLEFIN INSULATION

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 that of 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.

3.11 FIELD-APPLIED JACKET INSTALLATION

A. Where glass-cloth jackets are indicated, install directly over bare insulation or insulation with factory-applied jackets.

1. Draw jacket smooth and tight to surface with 2-inch overlap at seams and joints.
2. Embed glass cloth between two 0.062-inch thick coats of lagging adhesive.
3. Completely encapsulate insulation with coating, leaving no exposed insulation.

B. Where FSK jackets are indicated, install as follows:

1. Draw jacket material smooth and tight.
2. Install lap or joint strips with same material as jacket.
3. Secure jacket to insulation with manufacturer's recommended adhesive.
4. Install jacket with 1-1/2-inch laps at longitudinal seams and 3-inch wide joint strips at end joints.
5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.

C. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints. 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.

D. 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.

3.12 FINISHES

A. Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."

1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.

a. Finish Coat Material: Interior, flat, latex-emulsion size.

B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.

C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.

D. Do not field paint aluminum or stainless steel jackets.

3.13 FIELD QUALITY CONTROL

A. Owner will engage a qualified testing agency to perform tests and inspections.

B. Engage a qualified testing agency to perform tests and inspections.

C. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

D. Perform tests and inspections with the assistance of a factory-authorized service representative.

E. Tests and Inspections: 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.

F. All insulation applications will be considered defective if they do not pass tests and inspections.

G. Prepare test and inspection reports.

3.14 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.

3.15 INDOOR PIPING INSULATION SCHEDULE

A. Domestic Cold Water:

1. NPS 1 and Smaller: Insulation shall be one of the following:

a. Cellular Glass: 1-1/2 inches thick.

b. Flexible Elastomeric: 1 inch thick.
c. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
d. Phenolic: 1 inch thick.
e. Polyolefin: 1 inch thick.

2. NPS 1-1/4 and Larger: Insulation shall be one of the following:

a. Cellular Glass: 1-1/2 inches thick.
b. Flexible Elastomeric: 1 inch thick.
c. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
d. Phenolic: 1 inch thick.
e. Polyolefin: 1 inch thick.

B. Domestic Hot and Recirculated Hot Water:

1. NPS 1-1/4 and Smaller: Insulation shall be one of the following:

a. Cellular Glass: 1-1/2 inches thick.
b. Flexible Elastomeric: 1 inch thick.
c. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
d. Phenolic: 1 inch thick.
e. Polyolefin: 1 inch thick.

2. NPS 1-1/2 and Larger: Insulation shall be **one of** the following:

a. Cellular Glass: 1-1/2 inches thick.
b. Flexible Elastomeric: 1 inch thick.
c. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
d. Phenolic: 1 inch thick.
e. Polyolefin: 1 inch thick.

C. Stormwater and Overflow:

1. All Pipe Sizes: Insulation shall be one of the following:

a. Cellular Glass: 1-1/2 inches thick.
b. Flexible Elastomeric: 1 inch thick.
c. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
d. Phenolic: 1 inch thick.
e. Polyolefin: 1 inch thick.

D. Roof Drain and Overflow Drain Bodies:

1. All Pipe Sizes: Insulation shall be one of the following:

a. Cellular Glass: 1-1/2 inches thick.
b. Flexible Elastomeric: 1 inch thick.
c. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
d. Phenolic: 1 inch thick.
e. Polyolefin: 1 inch thick.

E. Exposed Sanitary Drains, Domestic Water, Domestic Hot Water, and Stops for Plumbing Fixtures for People with Disabilities:

1. All Pipe Sizes: Insulation shall be one of the following:

a. Flexible Elastomeric: 1 inch thick.
b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
c. Polyolefin: 1 inch thick.

F. Sanitary Waste Piping Where Heat Tracing Is Installed:

1. All Pipe Sizes: Insulation shall be one of the following:

a. Cellular Glass: 2 inches thick.
b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1-1/2 inches thick.
c. Phenolic: 1-1/2 inches thick.

G. Floor Drains, Traps, and Sanitary Drain Piping within 10 Feet of Drain Receiving Condensate and Equipment Drain Water below 60 Deg F:

1. All Pipe Sizes: Insulation shall be one of the following:

a. Cellular Glass: **1-1/2 inches** thick.
b. Flexible Elastomeric: **1 inch** thick.
c. Mineral-Fiber, Preformed Pipe Insulation, Type I: **1 inch** thick.
d. Phenolic: **1 inch** thick.
e. Polyolefin: **1 inch** thick.

3.16 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. Piping, Concealed:

1. None.

D. Piping, Exposed:

1. PVC, Color-Coded by System: 20 mils thick.
2. Aluminum, Smooth: 0.020 inch thick.
3. Painted Aluminum, Smooth: 0.020 inch thick.
4. Stainless Steel, Type 304 or Type 316, Smooth No. 2B Finish: 0.020 inch thick.

END OF SECTION 220719

SECTION 221113 - FACILITY WATER DISTRIBUTION PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes water-distribution piping and related components outside the building for water service.

B. Utility-furnished products include water meters that will be furnished to the site, ready for installation.

1.3 DEFINITIONS

A. EPDM: Ethylene propylene diene terpolymer rubber.

B. LLDPE: Linear, low-density polyethylene plastic.

C. PA: Polyamide (nylon) plastic.

D. PE: Polyethylene plastic.

E. PP: Polypropylene plastic.

F. PVC: Polyvinyl chloride plastic.

G. RTRF: Reinforced thermosetting resin (fiberglass) fittings.

H. RTRP: Reinforced thermosetting resin (fiberglass) pipe.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: Detail precast concrete vault assemblies and indicate dimensions, method of field assembly, and components.

1. Wiring Diagrams: Power, signal, and control wiring for alarms.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: For piping and specialties including relation to other services in same area, drawn to scale. Show piping and specialty sizes and valves, meter and specialty locations, and elevations.

B. Field quality-control test reports.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For water valves and specialties to include in emergency, operation, and maintenance manuals.

1.7 QUALITY ASSURANCE

A. Regulatory Requirements:

1. Comply with requirements of utility company supplying water. Include tapping of water mains and backflow prevention.
2. Comply with standards of authorities having jurisdiction for potable-water-service piping, including materials, installation, testing, and disinfection.
3. Comply with standards of authorities having jurisdiction for fire-suppression water-service piping, including materials, hose threads, installation, and testing.

B. Piping materials shall bear label, stamp, or other markings of specified testing agency.

C. 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.

D. Comply with ASTM F645 for selection, design, and installation of thermoplastic water piping.

E. Comply with FMG's "Approval Guide" or UL's "Fire Protection Equipment Directory" for fire-service-main products.

F. NFPA Compliance: Comply with NFPA 24 for materials, installations, tests, flushing, and valve and hydrant supervision for fire-service-main piping for fire suppression.

1. Potable-water piping and components shall comply with NSF 14, NSF 61, and NSF 372.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Preparation for Transport: Prepare valves, including fire hydrants, according to the following:

1. Ensure that valves are dry and internally protected against rust and corrosion.
2. Protect valves against damage to threaded ends and flange faces.
3. Set valves in best position for handling. Set valves closed to prevent rattling.

B. During Storage: Use precautions for valves, including fire hydrants, according to the following:

1. Do not remove end protectors unless necessary for inspection; then reinstall for storage.

2. Protect from weather. Store indoors and maintain temperature higher than ambient dew-point temperature. Support off the ground or pavement in watertight enclosures when outdoor storage is necessary.

C. Handling: Use sling to handle valves and fire hydrants if size requires handling by crane or lift. Rig valves to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

D. Deliver piping 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.

E. Protect stored piping from moisture and dirt. Elevate above grade. Do not exceed structural capacity of floor when storing inside.

F. Protect flanges, fittings, and specialties from moisture and dirt.

G. Store plastic piping protected from direct sunlight. Support to prevent sagging and bending.

1.9 PROJECT CONDITIONS

A. Interruption of Existing Water-Distribution Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary water-distribution service according to requirements indicated:

1. Notify Owner no fewer than two days in advance of proposed interruption of service.
2. Do not proceed with interruption of water-distribution service without Owner's written permission.

1.10 COORDINATION

A. Coordinate connection to water main with utility company.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

A. Comply with requirements in "Piping Application" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

B. Potable-water piping and components shall comply with NSF 14, NSF 61, and NSF 372.

2.2 COPPER TUBE AND FITTINGS

A. Soft Copper Tube: ASTM B88, Type K and ASTM B88, Type L water tube, annealed temper.

1. Copper, Solder-Joint Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint pressure type. Furnish only wrought-copper fittings if indicated.

B. Hard Copper Tube: ASTM B88, Type K and ASTM B88, Type L, water tube, drawn temper.

1. Copper, Solder-Joint Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint pressure type. Furnish only wrought-copper fittings if indicated.

C. Bronze Flanges: ASME B16.24, Class 150, with solder-joint end. Furnish Class 300 flanges if required to match piping.

D. Copper Unions:

1. MSS SP-123.
2. Cast-copper-alloy, hexagonal-stock body.
3. Ball-and-socket, metal-to-metal seating surfaces.
4. Solder-joint or threaded ends.

E. Copper, Brass or Bronze, Pressure-Seal-Joint Fittings:

1. Fittings: Cast-brass, cast-bronze, or wrought-copper with EPDM O-ring seal in each end. Sizes NPS 2-1/2 and larger with stainless steel grip ring and EPDM O-ring seal.
2. Minimum 200-psig working-pressure rating at 250 deg F.

2.3 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, Ductile-Iron Pipe: AWWA C151, with cut, rounded-grooved ends.

1. Grooved-End, Ductile-Iron Pipe Appurtenances:

a. Grooved-End, Ductile-Iron Fittings: ASTM A47/A47M, malleable-iron castings or ASTM A536, ductile-iron castings with dimensions matching pipe.

b. 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.

2.4 SPECIAL PIPE FITTINGS

A. Ductile-Iron Rigid Expansion Joints:

1. Description: Three-piece, ductile-iron assembly consisting of telescoping sleeve 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.

    a. Pressure Rating: 250 psig minimum.

B. Ductile-Iron Flexible Expansion Joints:

1. Description: Compound, ductile-iron fitting with combination of flanged and mechanical-joint ends complying with AWWA C110 or AWWA C153. Include two gasketed ball-joint sections and one or more gasketed sleeve sections. Assemble components for offset and expansion indicated. Include AWWA C111, ductile-iron glands, rubber gaskets, and steel bolts.

    a. Pressure Rating: 250 psig minimum.

C. Ductile-Iron Deflection Fittings:

1. Description: Compound, ductile-iron coupling fitting with sleeve and 1 or 2 flexing sections for up to 15-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.

    a. Pressure Rating: 250 psig minimum.

2.5 JOINING MATERIALS

A. Refer to Section 330500 "Common Work Results for Utilities" for commonly used joining materials.

B. Brazing Filler Metals: AWS A5.8, BCuP Series.

C. Bonding Adhesive for Fiberglass Piping: As recommended by fiberglass piping manufacturer.

D. Plastic Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.

2.6 PIPING SPECIALTIES

A. Transition Fittings: Manufactured fitting or coupling same size as, with pressure rating at least equal to and ends compatible with, piping to be joined.

B. Tubular-Sleeve Pipe Couplings:

1. Description: Metal, bolted, sleeve-type, reducing or transition coupling, with center sleeve, gaskets, end rings, and bolt fasteners and with ends of same sizes as piping to be joined.

    a. Standard: AWWA C219.
    b. Center-Sleeve Material: Carbon steel, Stainless steel, Ductile iron or Malleable iron.
    c. Gasket Material: Natural or synthetic rubber.
    d. Pressure Rating: 150 psig minimum.
    e. Metal Component Finish: Corrosion-resistant coating or material.

C. Split-Sleeve Pipe Couplings:

1. Description: Metal, bolted, split-sleeve-type, reducing or transition coupling with sealing pad and closure plates, O-ring gaskets, and bolt fasteners.

   a. Standard: AWWA C219.
   b. Sleeve Material: Carbon steel or Stainless steel.
   c. Sleeve Dimensions: Of thickness and width required to provide pressure rating.
   d. Gasket Material: O-rings made of EPDM rubber, unless otherwise indicated.
   e. Pressure Rating: 150 psig minimum.
   f. Metal Component Finish: Corrosion-resistant coating or material.

D. Flexible Connectors:

1. Nonferrous-Metal Piping: Bronze hose covered with bronze wire braid; with copper-tube, pressure-type, solder-joint ends or bronze flanged ends brazed to hose.
2. Ferrous-Metal Piping: Stainless-steel hose covered with stainless-steel wire braid; with ASME B1.20.1, threaded steel pipe nipples or ASME B16.5, steel pipe flanges welded to hose.

E. Dielectric Fittings:

1. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.
2. Dielectric Unions:

   a. Description:

      1) Standard: ASSE 1079.
      2) Pressure Rating: 125 psig minimum at 180 deg F .
      3) End Connections: Solder-joint copper alloy and threaded ferrous.

3. Dielectric Flanges:

   a. Description:

      1) Standard: ASSE 1079.
      2) Factory-fabricated, bolted, companion-flange assembly.
      3) Pressure Rating: 125 psig minimum at 180 deg F .
      4) End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

4. Dielectric-Flange Insulating Kits:

   a. Description:

      1) Nonconducting materials for field assembly of companion flanges.
      2) Pressure Rating: 150 psig .
      3) Gasket: Neoprene or phenolic.
      4) Bolt Sleeves: Phenolic or polyethylene.
      5) Washers: Phenolic with steel backing washers.

5. Dielectric Nipples:

   a. Description:

1) Standard: IAPMO PS 66.
2) Electroplated steel nipple complying with ASTM F1545.
3) Pressure Rating: 300 psig at 225 deg F .
4) End Connections: Male threaded or grooved.
5) Lining: Inert and noncorrosive, propylene.

2.7 CORROSION-PROTECTION PIPING ENCASEMENT

A. Encasement for Underground Metal Piping:

1. Standards: ASTM A674 or AWWA C105.
2. Form: Sheet or tube.
3. Material: LLDPE film of 0.008-inch minimum thickness.
4. Material: LLDPE film of 0.008-inch minimum thickness, or high-density, crosslaminated PE film of 0.004-inch minimum thickness.
5. Material: High-density, crosslaminated PE film of 0.004-inch minimum thickness.
6. Color: Black.

2.8 GATE VALVES – See section 22 05 23.15

2.9 GATE VALVE ACCESSORIES AND SPECIALTIES

A. Tapping-Sleeve Assemblies:

1. Description: Sleeve and valve compatible with drilling machine.

a. Standard: MSS SP-60.
b. Tapping Sleeve: Cast- or ductile-iron or stainless-steel, two-piece bolted sleeve with flanged outlet for new branch connection. Include sleeve matching size and type of pipe material being tapped and with recessed flange for branch valve.
c. Valve: AWWA, cast-iron, nonrising-stem, metal or resilient-seated gate valve with one raised face flange mating tapping-sleeve flange.

B. Valve Boxes: Comply with AWWA M44 for cast-iron valve boxes. Include top section, adjustable extension of length required for depth of burial of valve, plug with lettering "WATER," and bottom section with base that fits over valve and with a barrel approximately 5 inches in diameter.

1. Operating Wrenches: Steel, tee-handle with one pointed end, stem of length to operate deepest buried valve, and socket matching valve operating nut.

C. Indicator Posts: UL 789, FMG-approved, vertical-type, cast-iron body with operating wrench, extension rod, and adjustable cast-iron barrel of length required for depth of burial of valve.

2.10 CHECK VALVES – See section 22 05 23.14

2.11 BUTTERFLY VALVES – See section 22 05 23.13

2.12 PLUG VALVES

A. Plug Valves:

1. Description: Resilient-seated eccentric.

a. Standard: MSS SP-108.
b. Body: Cast iron.
c. Pressure Rating: 175-psig minimum CWP.
d. Seat Material: Suitable for potable-water service.

2.13 WATER METERS

A. Water meters will be furnished by utility company.

B. Displacement-Type Water Meters:

1. Description: With bronze main case.

a. Standard: AWWA C700.
b. Registration: Flow in gallons .

C. Turbine-Type Water Meters:

1. Description:

a. Standard: AWWA C701.
b. Registration: Flow in gallons .

D. Compound-Type Water Meters:

1. Description:

a. Standard: AWWA C702.
b. Registration: Flow in gallons .

E. Remote Registration System:

1. Description: Utility company standard; direct-reading type. Include meter modified with signal-transmitting assembly, low-voltage connecting wiring, and remote register assembly.

a. Standard: AWWA C706.
b. Registration: Flow in gallons .

F. Remote Registration System:

1. Description: Utility company standard; encoder type. Include meter modified with signal-transmitting assembly, low-voltage connecting wiring, and remote register assembly.

    a. Standard: AWWA C707.
    b. Registration: Flow in gallons .
    c. Data-Acquisition Units: Comply with utility company requirements for type and quantity.
    d. Visible Display Units: Comply with utility company requirements for type and quantity.

2.14 DETECTOR-TYPE WATER METERS

A. Description: Main line, proportional meter with second meter on bypass. Register flow in gallons .

1. Standards: AWWA C703, UL listed, and FMG approved.
2. Pressure Rating: 150 psig.
3. Bypass Meter: AWWA C701, turbine or AWWA C702, compound-type, bronze case.

    a. Size: At least one-half nominal size of main-line meter.

B. Description: Main-line turbine meter with strainer and second meter on bypass. Register flow in gallons .

1. Standards: AWWA C703, UL listed, and FMG approved.
2. Pressure Rating: 175 psig.
3. Bypass Meter: AWWA C701, turbine-type, bronze case.

    a. Size: At least NPS 2.

C. Remote Registration System:

1. Description: Utility company standard; direct-reading type. Include meter modified with signal-transmitting assembly, low-voltage connecting wiring, and remote register assembly.

    a. Standard: AWWA C706.
    b. Registration: Flow in gallons .

D. Remote Registration System:

1. Description: Utility company standard; encoder type. Include meter modified with signal-transmitting assembly, low-voltage connecting wiring, and remote register assembly.

    a. Standard: AWWA C707.
    b. Registration: Flow in gallons.
    c. Data-Acquisition Units: Comply with utility company requirements for type and quantity.
    d. Visible Display Units: Comply with utility company requirements for type and quantity.

2.15 RELIEF VALVES

A. Air-Release Valves:

1. Description: Hydromechanical device to automatically release accumulated air.

a. Standard: AWWA C512.
b. Pressure Rating: 300 psig .
c. Body Material: Cast iron.
d. Trim Material: Stainless steel, brass, or bronze.

B. Air/Vacuum Valves:

1. Description: Direct-acting, float-operated, hydromechanical device with large orifice to automatically release accumulated air or to admit air during filling of piping.

a. Standard: AWWA C512.
b. Pressure Rating: 300 psig .
c. Body Material: Cast iron.
d. Trim Material: Stainless steel**, brass, or bronze**.

C. Combination Air Valves:

1. Description: Float-operated, hydromechanical device to automatically release accumulated air or to admit air.

a. Standard: AWWA C512.
b. Pressure Rating: 300 psig .
c. Body Material: Cast iron.
d. Trim Material: Stainless steel, brass, or bronze.

2.16 FIRE DEPARTMENT CONNECTIONS

A. Fire Department Connections:

1. Description: Freestanding, with cast-bronze body, thread inlets according to NFPA 1963 and matching local fire department hose threads, and threaded bottom outlet. Include lugged caps, gaskets, and chains; lugged swivel connection and drop clapper for each hose-connection inlet; 18-inch- high brass sleeve; and round escutcheon plate.

a. Standard: UL 405.
b. Connections: Two NPS 2-1/2 inlets and one NPS 4 outlet.
c. Inlet Alignment: Inline, horizontal.
d. Finish Including Sleeve: Rough chrome-plated.
e. Escutcheon Plate Marking: "AUTO SPKR."

2.17 ALARM DEVICES

A. Alarm Devices, General: UL 753 and FMG approved, of types and sizes to mate and match piping and equipment.

B. Water-Flow Indicators: Vane-type water-flow detector, rated for 250-psig working pressure; designed for horizontal or vertical installation; with 2 single-pole, double-throw circuit switches to provide 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 when cover is removed.

C. Supervisory Switches: Single pole, double throw; designed to signal valve in other than fully open position.

D. Pressure Switches: Single pole, double throw; designed to signal increase in pressure.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Refer to Section 312000 "Earth Moving" for excavating, trenching, and backfilling.

3.2 PIPING APPLICATIONS

A. General: Use pipe, fittings, and joining methods for piping systems according to the following applications.

B. Transition couplings and special fittings with pressure ratings at least equal to piping pressure rating may be used, unless otherwise indicated.

C. Do not use flanges or unions for underground piping.

D. Flanges, unions, grooved-end-pipe couplings, and special fittings may be used, instead of joints indicated, on aboveground piping and piping in vaults.

E. Underground water-service piping NPS 3/4 to NPS 3 shall be the following:

1. Soft copper tube, ASTM B88, Type K or ASTM B88, Type L; wrought-copper, solder-joint fittings; and brazed or copper, pressure-seal fittings; and pressure-sealed joints.

F. Underground water-service piping NPS 4 to NPS 8 shall be any of the following:

1. Ductile-iron, mechanical-joint pipe; ductile-iron, mechanical-joint fittings; and mechanical or grooved-end pipe; ductile-iron-pipe appurtenances; and grooved joints.

3.3 PIPING SYSTEMS - COMMON REQUIREMENTS

A. See Section 330500 "Common Work Results for Utilities" for piping-system common requirements.

3.4 PIPING INSTALLATION

A. Install ductile-iron, water-service piping according to AWWA C600 and AWWA M41.

1. Install PE corrosion-protection encasement according to ASTM A674 or AWWA C105.

B. Bury piping with depth of cover over top at least 30 inches , with top at least 12 inches below level of maximum frost penetration, and according to the following:

C. Extend water-service piping and connect to water-supply source and building-water-piping systems at outside face of building wall in locations and pipe sizes indicated.

1. Terminate water-service piping at building wall until building-water-piping systems are installed. Terminate piping with caps, plugs, or flanges as required for piping material. Make connections to building-water-piping systems when those systems are installed.

D. Sleeves are specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

E. Mechanical sleeve seals are specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

F. Install underground piping with restrained joints at horizontal and vertical changes in direction. Use restrained-joint piping, thrust blocks, anchors, tie-rods and clamps, and other supports.

G. See Section 221116 "Domestic Water Piping" for potable-water piping inside the building.

3.5 INSTALLATION OF HANGERS AND SUPPORTS

A. Comply with requirements for hangers, supports, and anchor devices specified in Section 22 05229 "Hangers and Supports for Plumbing Piping and Equipment."

3.6 JOINT CONSTRUCTION

A. See Section 330500 "Common Work Results for Utilities" for basic piping joint construction.

B. Make pipe joints according to the following:

1. Copper-Tubing, Pressure-Sealed Joints: Join copper tube and pressure-seal fittings with tools and procedures recommended by pressure-seal-fitting manufacturer. Leave insertion marks on pipe after assembly.
2. Ductile-Iron Piping, Gasketed Joints for Water-Service Piping: AWWA C600 and AWWA M41.
3. Ductile-Iron Piping, Grooved Joints: Cut-groove pipe. Assemble joints with grooved-end, ductile-iron-piping couplings, gaskets, lubricant, and bolts according to coupling manufacturer's written instructions.
4. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.

    a. Dielectric Fittings for NPS 2 and Smaller: Use dielectric nipples or unions.
    b. Dielectric Fittings for NPS 2-1/2 to NPS 4: Use dielectric flanges or flange kits or nipples.
    c. Dielectric Fittings for NPS 6 and Larger: Use dielectric flange kits.

3.7 ANCHORAGE INSTALLATION

A. Anchorage, General: Install water-distribution piping with restrained joints. Anchorages and restrained-joint types that may be used include the following:

1. Concrete thrust blocks.
2. Locking mechanical joints.
3. Set-screw mechanical retainer glands.
4. Bolted flanged joints.
5. Pipe clamps and tie rods.

B. Install anchorages for tees, plugs and caps, bends, crosses, valves, and hydrant branches. Include anchorages for the following piping systems:

1. Gasketed-Joint, Ductile-Iron, Water-Service Piping: According to AWWA C600.

C. Apply full coat of asphalt or other acceptable corrosion-resistant material to surfaces of installed ferrous anchorage devices.

3.8 VALVE INSTALLATION

A. AWWA Gate Valves: Comply with AWWA C600 and AWWA M44. Install each underground valve with stem pointing up and with valve box.

B. AWWA Valves Other Than Gate Valves: Comply with AWWA C600 and AWWA M44.

C. UL/FMG, Gate Valves: Comply with NFPA 24. Install each underground valve and valves in vaults with stem pointing up and with vertical cast-iron indicator post.

D. UL/FMG, Valves Other Than Gate Valves: Comply with NFPA 24.

E. MSS Valves: Install as component of connected piping system.

F. Corporation Valves and Curb Valves: Install each underground curb valve with head pointed up and with service box.

G. Relief Valves: Comply with AWWA C512. Install aboveground with shutoff valve on inlet.

3.9 VACUUM BREAKER ASSEMBLY INSTALLATION

A. Install pressure vacuum breaker assemblies of type, size, and capacity indicated. Include valves and test cocks. Install according to requirements of plumbing and health department and authorities having jurisdiction.

B. Do not install pressure vacuum breaker assemblies in vault or other space subject to flooding.

3.10 FIRE DEPARTMENT CONNECTION INSTALLATION

A. Install ball drip valves at each check valve for fire department connection to mains.

3.11 CONNECTIONS

A. See Section 330500 "Common Work Results for Utilities" for piping connections to valves and equipment.

B. Connect water-distribution piping to interior domestic water piping.

C. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."

D. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.12 FIELD QUALITY CONTROL

A. Piping Tests: Conduct piping tests before joints are covered and after concrete thrust blocks have hardened sufficiently. Fill pipeline 24 hours before testing and apply test pressure to stabilize system. Use only potable water.

B. Hydrostatic Tests: Test at not less than one-and-one-half times working pressure for two hours.

1. Increase pressure in 50-psig increments and inspect each joint between increments. Hold at test pressure for 1 hour; decrease to 0 psig. Slowly increase again to test pressure and hold for 1 more hour. Maximum allowable leakage is 2 quarts per hour per 100 joints. Remake leaking joints with new materials and repeat test until leakage is within allowed limits.

C. Prepare reports of testing activities.

3.13 IDENTIFICATION

A. Install continuous underground warning tape during backfilling of trench for underground water-distribution piping. Locate below finished grade, directly over piping. Underground warning tapes are specified in Section 312000 "Earth Moving."

B. Permanently attach equipment nameplate or marker indicating plastic water-service piping, on main electrical meter panel. See Section 330500 "Common Work Results for Utilities" for identifying devices.

3.14 CLEANING

A. Clean and disinfect water-distribution piping as follows:

1. Purge new water-distribution piping systems and parts of existing systems that have been altered, extended, or repaired before use.
2. Use purging and disinfecting procedure prescribed by authorities having jurisdiction or, if method is not prescribed by authorities having jurisdiction, use procedure described in NFPA 24 for flushing of piping. Flush piping system with clean, potable water until dirty water does not appear at points of outlet.
3. Use purging and disinfecting procedure prescribed by authorities having jurisdiction or, if method is not prescribed by authorities having jurisdiction, use procedure described in AWWA C651 or do as follows:

a. Fill system or part of system with water/chlorine solution containing at least 50 ppm of chlorine; isolate and allow to stand for 24 hours.
b. Drain system or part of system of previous solution and refill with water/chlorine solution containing at least 200 ppm of chlorine; isolate and allow to stand for 3 hours.
c. After standing time, flush system with clean, potable water until no chlorine remains in water coming from system.
d. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedure if biological examination shows evidence of contamination.

B. Prepare reports of purging and disinfecting activities.

END OF SECTION 221113

SECTION 221116 - DOMESTIC WATER PIPING

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. Copper tube and fittings.
2. PVC pipe and fittings.
3. Piping joining materials.
4. Encasement for piping.
5. Transition fittings.
6. Dielectric fittings.

B. Related Requirements:

1. Section 221113 "Facility Water Distribution Piping" for water-service piping outside the building from source to the point where water-service piping enters the building.

1.3 ACTION SUBMITTALS

A. Product Data:

1. Pipe and tube.
2. Fittings.
3. Joining materials.
4. Transition fittings.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Piping layout, or BIM model, drawn to scale, showing the items described in this Section, and coordinated with all building trades.

B. System purging and disinfecting activities report.

C. Field quality-control reports.

1.5 FIELD CONDITIONS

A. Interruption of Existing Water Service: Do not interrupt water service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary water service according to requirements indicated:

1. Notify Owner no fewer than two days in advance of proposed interruption of water service.
2. Do not interrupt water service without Owner's written permission.

1.6 WARRANTY

A. Polypropylene Piping (PP-R) Manufacturer's Warranty: Manufacturer agrees to repair or replace PP-R pipe and fittings that fail in materials or workmanship within 10 years from date of Substantial Completion.

1. Warranty is to cover labor and material costs of repairing and/or replacing defective materials and repairing any incidental damage caused by failure of the piping system due to defects in materials or manufacturing.
2. Warranty is to be in effect only upon submission by the Contractor to the manufacturer of valid pressure/leak documentation indicating that the system was tested and passed the manufacturer's pressure/leak test.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

A. Potable-water piping and components shall comply with NSF 14, NSF 61, and NSF 372. Include marking "NSF-pw" on piping.

2.2 COPPER TUBE AND FITTINGS

A. Drawn-Temper Copper Tube: ASTM B88, Type K or ASTM B88, Type L.

B. Annealed-Temper Copper Tube: ASTM B88, Type K or ASTM B88, Type L .

C. Cast-Copper, Solder-Joint Fittings: ASME B16.18, pressure fittings.

D. Wrought-Copper, Solder-Joint Fittings: ASME B16.22, pressure fittings.

E. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.

F. Cast 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.

G. Wrought Copper Unions: ASME B16.22.

H. Copper-Tube, Mechanically Formed Tee Fitting: For forming T-branch on copper water tube.
1. Description: Tee formed in copper tube in accordance with ASTM F2014.

I. Grooved, Mechanical-Joint, Copper Tube Appurtenances:

1. Grooved-End, Copper Fittings: ASTM B75 copper tube or ASTM B584 bronze castings.
2. Grooved-End-Tube Couplings: To fit copper-tube dimensions; rigid pattern unless otherwise indicated; gasketed fitting, EPDM-rubber gasket, UL classified per NSF 61 and NSF 372, and rated for minimum 180 deg F , for use with ferrous housing and steel bolts and nuts; 300 psig minimum CWP pressure rating.

J. Copper Tube, Pressure-Seal-Joint Fittings:

1. Fittings: Cast-brass, cast-bronze, or wrought-copper with EPDM O-ring seal in each end.
2. Minimum 200-psig working-pressure rating at 250 deg F.

K. Copper-Tube, Push-on-Joint Fittings:

1. Description:

a. Cast-copper fitting complying with ASME B16.18 or wrought-copper fitting complying with ASME B 16.22.
b. Stainless steel teeth and EPDM-rubber, O-ring seal in each end instead of solder-joint ends.

2.3 PVC PIPE AND FITTINGS

A. PVC Pipe: ASTM D1785, with wall thickness as indicated in "Piping Applications" Article.

1. <Double click here to find, evaluate, and insert list of manufacturers and products.>

B. PVC Socket Fittings: ASTM D2466 for Schedule 40.

2.4 PIPING JOINING MATERIALS

A. Pipe-Flange Gasket Materials:

1. AWWA C110/A21.10, rubber, flat face, 1/8 inch thick or ASME B16.21, nonmetallic and asbestos free unless otherwise indicated.
2. 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 B32, lead-free alloys.

D. Flux: ASTM B813, water flushable.

E. Brazing Filler Metals: AWS A5.8M/A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.

F. Solvent Cements for Joining PVC Piping: ASTM D2564. Include primer according to ASTM F656.

G. Plastic, Pipe-Flange Gaskets, Bolts, and Nuts: Type and material recommended by piping system manufacturer unless otherwise indicated.

2.5 ENCASEMENT FOR PIPING

A. Standard: ASTM A674 or AWWA C105/A21.5.

B. Form: Sheet or tube.

C. Color: Black.

2.6 TRANSITION FITTINGS

A. General Requirements:

1. Same size as pipes to be joined.
2. Pressure rating at least equal to pipes to be joined.
3. End connections compatible with pipes to be joined.

B. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.

C. Sleeve-Type Transition Coupling: AWWA C219.

D. Plastic-to-Metal Transition Fittings:
1. Description:

a. PVC one-piece fitting with manufacturer's Schedule 80 equivalent dimensions.
b. One end with threaded brass insert and one solvent-cement-socket or threaded end.

2.7 DIELECTRIC FITTINGS

A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.

B. Dielectric Unions:

1. Standard: ASSE 1079.
2. Pressure Rating: 125 psig minimum at 180 deg F .
3. End Connections: Solder-joint copper alloy and threaded ferrous.

C. Dielectric Flanges:

1. Standard: ASSE 1079.
2. Factory-fabricated, bolted, companion-flange assembly.
3. Pressure Rating: 125 psig minimum at 180 deg F .
4. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

D. Dielectric-Flange Insulating Kits:

1. Nonconducting materials for field assembly of companion flanges.
2. Pressure Rating: 150 psig .
3. Gasket: Neoprene or phenolic.
4. Bolt Sleeves: Phenolic or polyethylene.
5. Washers: Phenolic with steel backing washers.

E. Dielectric Nipples:

1. Standard: IAPMO PS 66.
2. Electroplated steel nipple complying with ASTM F1545.
3. Pressure Rating and Temperature: 300 psig at 225 deg F .
4. End Connections: Male threaded or grooved.
5. Lining: Inert and noncorrosive, propylene.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

A. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.

B. Flanges and unions may be used for aboveground piping joints unless otherwise indicated.

C. Fitting Option: Extruded-tee connections and brazed joints may be used on aboveground copper tubing.

D. , shall be the following:

E. Under-building-slab, domestic water piping, NPS 2 and smaller, shall be the following:
1. PVC, Schedule 40; socket fittings; and solvent-cemented joints.

F. Aboveground domestic water piping, NPS 2 and smaller , shall be one of the following:

1. Drawn-temper copper tube, ASTM B88, Type L cast or wrought copper, solder-joint fittings; and **brazed** or **soldered** joints.
2. Drawn-temper copper tube, ASTM B88, Type L; copper pressure-seal-joint fittings; and pressure-sealed joints.
3. Drawn-temper copper tube, ASTM B88, Type L copper push-on-joint fittings; and push-on joints.

G. Aboveground domestic water piping, NPS 2-1/2 to NPS 6 , shall be one of the following:

1. Drawn-temper copper tube, ASTM B88, Type L cast or wrought copper, solder-joint fittings; and brazed or soldered joints.
2. Drawn-temper copper tube, ASTM B88, Type L copper pressure-seal-joint fittings; and pressure-sealed joints.
3. Drawn-temper copper tube, ASTM B88, Type L; grooved-joint, copper-tube appurtenances; and grooved joints.

3.2 EARTHWORK

A. Comply with requirements in Section 312000 "Earth Moving" for excavating, trenching, and backfilling.

3.3 INSTALLATION OF PIPING

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 underground **copper tube** in PE encasement according to ASTM A674 or AWWA C105/A21.5.

E. Install valves according to the following:

1. Section 220523.12 "Ball Valves for Plumbing Piping."
2. Section 220523.13 "Butterfly Valves for Plumbing Piping."
3. Section 220523.14 "Check Valves for Plumbing Piping."
4. Section 220523.15 "Gate Valves for Plumbing Piping."

F. Install domestic water piping level and plumb.

G. Rough-in domestic water piping for water-meter installation according to utility company's requirements.

H. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.

I. 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.

J. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.

K. Install piping to permit valve servicing.

L. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than the system pressure rating used in applications below unless otherwise indicated.

M. Install piping free of sags and bends.

N. Install fittings for changes in direction and branch connections.

O. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.

P. Install pressure gauges on suction and discharge piping for each plumbing pump and packaged booster pump. Comply with requirements for pressure gauges in Section 220519 "Meters and Gages for Plumbing Piping."

Q. Install thermostats in hot-water circulation piping. Comply with requirements for thermostats in Section 221123 "Domestic Water Pumps."

R. Install thermometers on inlet and outlet piping from each water heater. Comply with requirements for thermometers in Section 220519 "Meters and Gages for Plumbing Piping."

S. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

T. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

U. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 220518 "Escutcheons for Plumbing Piping."

3.4 JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

B. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.

C. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.

D. Brazed Joints for Copper Tubing: Comply with CDA's "Copper Tube Handbook," "Brazed Joints" chapter.

E. Soldered Joints for Copper Tubing: Apply ASTM B813, water-flushable flux to end of tube. Join copper tube and fittings according to ASTM B828 or CDA's "Copper Tube Handbook."

F. Pressure-Sealed Joints for Copper Tubing: Join copper tube and pressure-seal fittings with tools and procedure recommended by pressure-seal-fitting manufacturer. Leave insertion marks on pipe after assembly.

G. Extruded-Tee Connections: Form tee in copper tube according to ASTM F2014. 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.

H. Joint Construction for Grooved-End Copper Tubing: Make joints according to AWWA C606. Roll groove ends of tubes. Lubricate and install gasket over ends of tubes or tube and fitting. Install coupling housing sections over gasket with keys seated in tubing grooves. Install and tighten housing bolts.

I. Joint Construction for Grooved-End Steel Piping: Make joints according to AWWA C606. Square cut or Roll groove ends of pipe as specified. Lubricate and install gasket over ends of pipes or pipe and fitting. Install coupling housing sections over gasket with keys seated in piping grooves. Install and tighten housing bolts.

J. 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.

K. Joint Construction for Solvent-Cemented Plastic Piping: Clean and dry joining surfaces. Join pipe and fittings according to the following:

1. Comply with ASTM F402 for safe-handling practice of cleaners, primers, and solvent cements. Apply primer.
2. PVC Piping: Join according to ASTM D2855.

L. Joints for Dissimilar-Material Piping: Make joints using adapters compatible with materials of both piping systems.

3.5 INSTALLATION OF TRANSITION FITTINGS

A. Install transition couplings at joints of dissimilar piping.

B. Transition Fittings in Underground Domestic Water Piping:

1. Fittings for NPS 1-1/2 and Smaller: Fitting-type coupling.
2. Fittings for NPS 2 and Larger: Sleeve-type coupling.

C. Transition Fittings in Aboveground Domestic Water Piping NPS 2 (DN 50) and Smaller: Plastic-to-metal transition [**fittings**] [**or**] [**unions**].

3.6 INSTALLATION OF DIELECTRIC FITTINGS

A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.

B. Dielectric Fittings for NPS 2 and Smaller: Use dielectric couplings or nipples or unions.

C. Dielectric Fittings for NPS 2-1/2 to NPS 6 : Use dielectric flanges, flange kits or nipples.

3.7 INSTALLATION OF HANGERS AND SUPPORTS

A. Comply with requirements for seismic-restraint devices specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."

B. Comply with requirements for hangers, supports, and anchor devices in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."

C. Install hangers for copper tubing and piping, with maximum horizontal spacing and minimum rod diameters, to comply with MSS-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

D. Install vinyl-coated hangers forPVC piping, with maximum horizontal spacing and minimum rod diameters, to comply with manufacturer's written instructions, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

E. Support horizontal piping within 12 inches of each fitting.

F. Support vertical runs of copper tubing and piping to comply with MSS-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

3.8 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. When installing piping adjacent to equipment and machines, allow space for service and maintenance.

C. Connect domestic water piping to exterior water-service piping. Use transition fitting to join dissimilar piping materials.

D. Connect domestic water piping to water-service piping with shutoff valve; extend and connect to the following:

1. Water Heaters: Cold-water inlet and hot-water outlet piping in sizes indicated, but not smaller than sizes of water heater connections.
2. Plumbing Fixtures: Cold- and hot-water-supply piping in sizes indicated, but not smaller than that required by plumbing code.
3. Equipment: Cold- and hot-water-supply piping as indicated, but not smaller than equipment connections. Provide shutoff valve and union for each connection. Use flanges instead of unions for NPS 2-1/2 and larger.

3.9 IDENTIFICATION

A. Identify system components. Comply with requirements for identification materials and installation in Section 220553 "Identification for Plumbing Piping and Equipment."

3.10 ADJUSTING

A. Perform the following adjustments before operation:

1. Close drain valves, hydrants, and hose bibbs.
2. Open shutoff valves to fully open position.
3. Open throttling valves to proper setting.
4. Adjust balancing valves in hot-water-circulation return piping to provide adequate flow.

   a. Manually adjust ball-type balancing valves in hot-water-circulation return piping to provide hot-water flow in each branch.
   b. Adjust calibrated balancing valves to flows indicated.

5. Remove plugs used during testing of piping and for temporary sealing of piping during installation.
6. Remove and clean strainer screens. Close drain valves and replace drain plugs.
7. Remove filter cartridges from housings and verify that cartridges are as specified for application where used and are clean and ready for use.
8. Check plumbing specialties and verify proper settings, adjustments, and operation.

3.11 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Piping Inspections:

   a. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
   b. During installation, notify authorities having jurisdiction at least one day before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:

      1) Roughing-in Inspection: Arrange for inspection of piping before concealing or closing in after roughing in and before setting fixtures.

2) Final Inspection: Arrange for authorities having jurisdiction to observe tests specified in "Piping Tests" Subparagraph below and to ensure compliance with requirements.

c. Reinspection: If authorities having jurisdiction find that piping will not pass tests or inspections, make required corrections and arrange for reinspection.
d. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

2. Piping Tests:

a. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
b. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit a separate report for each test, complete with diagram of portion of piping tested.
c. Leave new, altered, extended, or replaced domestic water piping uncovered and unconcealed until it has been tested and approved. Expose work that was covered or concealed before it was tested.
d. Cap and subject piping to static water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow it to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
e. Hydrostatic testing and documentation of test results for polypropylene piping to be in accordance with the manufacturer's instructions and submitted to the manufacturer upon successful completion per warranty requirements.
f. Repair leaks and defects with new materials, and retest piping or portion thereof until satisfactory results are obtained.
g. Prepare reports for tests and for corrective action required.

B. Domestic water piping will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

3.12 CLEANING

A. Clean and disinfect potable domestic water piping as follows:

1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction; if methods are not prescribed, use procedures described in either AWWA C651 or AWWA C652 or follow procedures described below:

a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
b. Fill and isolate system according to either of the following:

1) Fill system or part thereof with water/chlorine solution with at least 50 ppm of chlorine. Isolate with valves and allow to stand for 24 hours.
2) Fill system or part thereof with water/chlorine solution with at least 200 ppm of chlorine. Isolate and allow to stand for three hours.

c. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.
d. Repeat procedures if biological examination shows contamination.
e. Submit water samples in sterile bottles to authorities having jurisdiction.

B. Clean non-potable domestic water piping as follows:

1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
2. Use purging procedures prescribed by authorities having jurisdiction or; if methods are not prescribed, follow procedures described below:

a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
b. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.

C. Prepare and submit reports of purging and disinfecting activities. Include copies of water-sample approvals from authorities having jurisdiction.

D. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

END OF SECTION 221116

SECTION 221119 - DOMESTIC WATER PIPING SPECIALTIES

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. Vacuum breakers.
2. Balancing valves.
3. Temperature-actuated, water mixing valves.
4. Strainers for domestic water piping.
5. Outlet boxes.
6. Hose bibbs.
7. Wall hydrants.
8. Drain valves.
9. Water-hammer arresters.
10. Trap-seal primer device.
11. Water meters.

B. Related Requirements:

1. Section 211100 "Facility Fire-Suppression Water-Service Piping" for fire water-service backflow prevention devices.
2. Section 220519 "Meters and Gauges for Plumbing Piping" for thermometers, pressure gauges, and flow meters in domestic water piping.
3. Section 221116 "Domestic Water Piping" for water meters.
4. Section 224500 "Emergency Plumbing Fixtures" for water tempering equipment.
5. Section 230923.18 "Leak Detection Instruments" for leak detection devices related to HVAC applications.

1.3 DEFINITIONS

A. AMI: Advanced Metering Infrastructure.

B. AMR: Automatic Meter Reading.

C. FKM: A family of fluroelastomer materials defined by ASTM D1418.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For domestic water piping specialties.

1. Include diagrams for power, signal, and control wiring.

1.5 INFORMATIONAL SUBMITTALS

A. Test and inspection reports.

B. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For domestic water piping specialties to include in emergency, operation, and maintenance manuals.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR PIPING SPECIALTIES

A. Domestic water piping specialties intended to convey or dispense water for human consumption are to comply with the SDWA, requirements of authorities having jurisdiction, and NSF 61 and NSF 372, or to be certified in compliance with NSF 61 and NSF 372 by an American National Standards Institute (ANSI)-accredited third-party certification body that the weighted average lead content at wetted surfaces is less than or equal to 0.25 percent.

2.2 PERFORMANCE REQUIREMENTS

A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig unless otherwise indicated.

2.3 VACUUM BREAKERS

A. Pipe-Applied, Atmospheric-Type Vacuum Breaker :

1. Standard: ASSE 1001.
2. Size: NPS 1/4 to NPS 3, as required to match connected piping.
3. Body: Bronze.
4. Inlet and Outlet Connections: Threaded.
5. Finish: Rough bronze or Chrome plated.

B. Hose-Connection Vacuum Breakers:

1. Standard: ASSE 1011.
2. Body: Bronze, nonremovable, with manual drain.
3. Outlet Connection: Garden-hose threaded complying with ASME B1.20.7.
4. Finish: Chrome or nickel plated or Rough bronze.

C. Pressure Vacuum Breakers:

1. Standard: ASSE 1020.
2. Operation: Continuous-pressure applications.
3. Pressure Loss: 5 psig maximum, through middle third of flow range.

4. Accessories:

    a. Valves: Ball type, on inlet and outlet.

D. Spill-Resistant Vacuum Breakers:

1. Standard: ASSE 1056.
2. Operation: Continuous-pressure applications.
3. Accessories:

    a. Valves: Ball type, on inlet and outlet.

2.4 BACKFLOW PREVENTERS

A. Intermediate Atmospheric-Vent Backflow Preventers:

1. Standard: ASSE 1012.
2. Operation: Continuous-pressure applications.
3. Body: Bronze.
4. End Connections: Union, solder joint.
5. Finish: Rough bronze.

B. Reduced-Pressure-Principle Backflow Preventers:

1. Standard: ASSE 1013.
2. Operation: Continuous-pressure applications.
3. Body: Bronze or stainless steel for NPS 2 and smaller; ductile or cast iron with interior lining that complies with AWWA C550 or that is FDA approved or stainless steel for NPS 2-1/2 and larger.
4. Accessories:

    a. Valves NPS 2 and Smaller: Ball type with threaded ends on inlet and outlet.
    b. Valves NPS 2-1/2 and Larger: Outside-screw and yoke-gate type with flanged ends on inlet and outlet.
    c. Air-Gap Fitting: ASME A112.1.2, matching backflow-preventer connection.

C. Hose-Connection Backflow Preventers:

1. Standard: ASSE 1052.
2. Inlet Size: NPS 3/4.
3. Outlet Size: Garden-hose thread complying with ASME B1.20.7.

D. Backflow-Preventer Test Kits:

1. Description: Factory calibrated, with gauges, fittings, hoses, and carrying case with test-procedure instructions.

2.5 BALANCING VALVES

A. Copper-Alloy Calibrated Balancing Valves:

1. Type: Ball valve with two readout ports and memory-setting indicator.
2. Body: Brass or bronze.
3. Size: Same as connected piping, but not larger than NPS 2.
4. Accessories: Meter hoses, fittings, valves, differential pressure meter, and carrying case.

B. Memory-Stop Balancing Valves:

1. Standard: MSS SP-110 for two-piece, copper-alloy ball valves.
2. Pressure Rating: 400-psig minimum CWP.
3. Size: NPS 2 or smaller.
4. Body: Copper alloy.
5. Port: Standard or full port.
6. Ball: Chrome-plated brass or stainless steel.
7. Seats and Seals: Replaceable.
8. End Connections: Solder joint or threaded.
9. Handle: Vinyl-covered steel with memory-setting device.

C. Automatic Flow Control Balancing Valves:

1. Flow Regulation: Plus or minus 5 percent over 95 percent of the working range.
2. Pressure Rating: 200 psig.
3. Size: NPS 2 or smaller.
4. Body: Stainless steel or brass.
5. Flow Cartridge: Stainless steel or antiscale polymer.
6. End Connections: Threaded or solder joint.

2.6 TEMPERATURE-ACTUATED, WATER MIXING VALVES

A. Water-Temperature Limiting Devices:

1. Standard: ASSE 1070.
2. Pressure Rating: 125 psig.
3. Type: Thermostatically controlled, water mixing valve.
4. Material: Bronze body with corrosion-resistant interior components.
5. Connections: Threaded union inlets and outlet.
6. Accessories: Check stops on hot- and cold-water supplies, and adjustable, temperature-control handle.

B. Primary, Thermostatic, Water Mixing Valves:

1. Standard: ASSE 1017.
2. Pressure Rating: 125 psig minimum unless otherwise indicated.
3. Type: Exposed-mounted, thermostatically controlled, water mixing valve.
4. Material: Bronze body with corrosion-resistant interior components.
5. Connections: Threaded union inlets and outlet.
6. Accessories: Manual temperature control, check stops on hot- and cold-water supplies, and adjustable, temperature-control handle.
7. Valve Finish: Chrome plated, Polished, chrome plated or Rough bronze.
8. Piping Finish: Chrome plated or Copper.
9. Cabinet: Factory fabricated, stainless steel, for surface mounting and with hinged, stainless steel door.

C. Individual-Fixture, Water Tempering Valves:

1. Standard: ASSE 1016, thermostatically controlled, water tempering valve.
2. Pressure Rating: 125 psig minimum unless otherwise indicated.
3. Material: Bronze body with corrosion-resistant interior components.
4. Temperature Control: Adjustable.
5. Connections: Threaded inlets and outlet.
6. Finish: Chrome plated.

D. Primary Water Tempering Valves:

1. Standard: ASSE 1017, thermostatically controlled, water tempering valve, listed as tempering valve.
2. Pressure Rating: 125 psig minimum unless otherwise indicated.
3. Material: Bronze body.
4. Temperature Control: Manual.
5. Connections: Threaded inlets and outlet.
6. Valve Finish: Rough bronze.

2.7 STRAINERS FOR DOMESTIC WATER PIPING

A. Y-Pattern Strainers:

1. Pressure Rating: 125 psig minimum unless otherwise indicated.
2. Body: Bronze for NPS 2 and smaller; cast iron for NPS 2-1/2 and larger.
3. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
4. Screen: Stainless steel with round perforations unless otherwise indicated.
5. Perforation Size:

    a. Strainers NPS 2 and Smaller: 0.020 inch.
    b. Strainers NPS 2-1/2 to NPS 6: 0.045 inch.

6. Drain: Pipe plug or Factory-installed, hose-end drain valve.

2.8 OUTLET BOXES

A. Icemaker Outlet Boxes:

1. Mounting: Recessed. Fire rated.
2. Material and Finish: See schedule.
3. Faucet: Valved fitting complying with ASME A112.18.1. Include NPS 1/2 or smaller copper tube outlet.
4. Accessory: Water hammer arrestor.
5. Supply Shutoff Fitting: NPS 1/2 gate, globe, or ball valve and NPS 1/2 copper, water tubing.

2.9 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 3/4 threaded or solder-joint inlet.
5. Outlet Connection: Garden-hose thread complying with ASME B1.20.7.
6. Pressure Rating: 125 psig.
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 or Chrome or nickel plated.
10. Finish for Finished Rooms: Chrome or nickel plated.
11. Operation for Equipment Rooms: Wheel handle or operating key.
12. Operation for Service Areas: Operating key.
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.

2.10 WALL HYDRANTS

A. Nonfreeze Wall Hydrants:

1. Standard: ASME A112.21.3M for exposed-outlet, self-draining wall hydrants.
2. Pressure Rating: 125 psig.
3. Operation: Loose key.
4. Casing and Operating Rod: Of length required to match wall thickness. Include wall clamp.
5. Inlet: NPS 3/4.
6. Outlet, Concealed: With integral vacuum breaker and garden-hose thread complying with ASME B1.20.7.
7. Box: Deep, flush mounted with cover.
8. Box and Cover Finish: See schedule.
9. Outlet, Exposed: With integral vacuum breaker and garden-hose thread complying with ASME B1.20.7.
10. Nozzle and Wall-Plate Finish: See schedule.
11. Operating Keys(s): One with each wall hydrant.

2.11 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 minimum CWP.
3. Size: NPS 3/4.
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.

2.12 WATER-HAMMER ARRESTERS

A. Water-Hammer Arresters:

1. Standard: ASSE 1010 or PDI-WH 201.
2. Type: See schedule
3. Size: ASSE 1010, Sizes AA and A through F, or PDI-WH 201, Sizes A through F.

2.13 FLEXIBLE CONNECTORS

A. Bronze-Hose Flexible Connectors: Corrugated-bronze tubing with bronze wire-braid covering and ends brazed to inner tubing.

1. Working-Pressure Rating: Minimum 200 psig.
2. End Connections NPS 2 and Smaller: Threaded copper pipe or plain-end copper tube.
3. End Connections NPS 2-1/2 and Larger: Flanged copper alloy.

B. Stainless Steel-Hose Flexible Connectors: Corrugated-stainless steel tubing with stainless steel wire-braid covering and ends welded to inner tubing.

1. Working-Pressure Rating: Minimum 200 psig.
2. End Connections NPS 2 and Smaller: Threaded steel-pipe nipple.
3. End Connections NPS 2-1/2 and Larger: Flanged steel nipple.

2.14 WATER METERS

A. Displacement-Type Water Meters:

1. Standard: AWWA C700.
2. Pressure Rating: 150-psig working pressure.
3. Body Design: Nutating disc; totalization meter.
4. Registration: In gallons or cubic feet as required by utility company.

a. 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.

1) System shall be capable of transmitting data using AMR/AMI technology.

5. Case: Bronze or Stainless steel.
6. End Connections: Threaded or flanged.

B. Turbine-Type Water Meters:

1. Standard: AWWA C701.
2. Pressure Rating: 150 psig working pressure.
3. Body Design: Turbine; totalization meter.
4. Registration: In gallons or cubic feet as required by utility company.

a. 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.

1) System shall be capable of transmitting data using AMR/AMI technology.

5. Case: Bronze or Epoxy-coated cast iron.
6. End Connections: Threaded or flanged.

PART 3 - EXECUTION

3.1 INSTALLATION OF PIPING SPECIALTIES

A. Backflow Preventers: Install 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 unacceptable for this application.

3. Do not install bypass piping around backflow preventers.

B. Water Regulators: Install with inlet and outlet shutoff valves. Install pressure gauges on inlet and outlet.

C. Water Control Valves: Install with inlet and outlet shutoff valves. Install pressure gauges on inlet and outlet.

D. Balancing Valves: Install in locations where they can easily be adjusted. Set at indicated design flow rates.

E. Temperature-Actuated, Water Mixing Valves: Install with check stops or shutoff valves on inlets and with shutoff valve on outlet.

F. Outlet Boxes: Install boxes recessed in wall or surface mounted on wall. Install 1-1/2-by-3-1/2-inch fire-retardant-treated-wood blocking, wall reinforcement between studs. Comply with requirements for fire-retardant-treated-wood blocking in Section 061000 "Rough Carpentry."

G. Hose Stations: Install with check stops or shutoff valves on inlets and with thermometer on outlet.

1. Install cabinet-type units recessed in or surface mounted on wall as specified. Install 1-1/2-by-3-1/2-inch fire-retardant-treated-wood blocking, wall reinforcement between studs. Comply with requirements for fire-retardant-treated-wood blocking in Section 061000 "Rough Carpentry."

H. Water-Hammer Arresters: Install in water piping in accordance with PDI-WH 201.

3.2 PIPING CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. When installing piping specialties adjacent to equipment and machines, allow space for service and maintenance.

3.3 IDENTIFICATION

A. Plastic Labels for Equipment: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:

1. Vacuum breakers.
2. Backflow preventers.
3. Balancing valves.
4. Temperature-actuated, water mixing valves.
5. Outlet boxes.
6. Hose stations.
7. Wall hydrants.
8. Water meters.

B. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to

identifying unit. Nameplates and signs are specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.4 ADJUSTING

A. Set field-adjustable pressure set points of water pressure-reducing valves.

B. Set field-adjustable flow set points of balancing valves.

C. Set field-adjustable temperature set points of temperature-actuated, water mixing valves.

D. Adjust each pressure vacuum breaker and reduced-pressure-principle backflow preventer in accordance with manufacturer's written instructions, authorities having jurisdiction and the device's reference standard.

3.5 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

C. Perform the following tests and inspections with the assistance of a factory-authorized service representative.

1. Test each pressure vacuum breaker and reduced-pressure-principle backflow preventer according to authorities having jurisdiction and the device's reference standard.
2. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
3. Operational Test: After electrical circuitry has been energized, start units to confirm unit operation.
4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

D. Domestic water piping specialties will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports.

END OF SECTION 221119

SECTION 221123.21 - INLINE, DOMESTIC-WATER PUMPS

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. In-line, sealless centrifugal pumps.
2. Horizontally mounted, in-line, close-coupled centrifugal pumps.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product. Include construction materials, rated capacities, certified performance curves with operating points plotted on curves, operating characteristics, electrical characteristics, and furnished specialties and accessories.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Detail pumps and adjacent equipment. Show support locations, type of support, weight on each support, required clearances, and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Structural members to which pumps will be attached.
2. Size and location of initial access modules for acoustical tile.

B. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For inline, domestic-water pumps to include in operation and maintenance manuals.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Retain shipping flange protective covers and protective coatings during storage.

B. Protect bearings and couplings against damage.

C. Comply with pump manufacturer's written instructions for handling.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. UL Compliance: UL 778 for motor-operated water pumps.

C. Drinking Water System Components - Health Effects and Drinking Water System Components - Lead Content Compliance: NSF 61 and NSF 372.

2.2 IN-LINE, SEALLESS CENTRIFUGAL PUMPS

A. Description: Factory-assembled and -tested, in-line, close-coupled, canned-motor, sealless, overhung-impeller centrifugal pumps.

B. Capacities and Characteristics: See schedule

C. Pump Construction:

1. Pump and Motor Assembly: Hermetically sealed, replaceable-cartridge type with motor and impeller on common shaft and designed for installation with pump and motor shaft horizontal.
2. Minimum Working Pressure: 125 psig.
3. Maximum Continuous Operating Temperature: 220 deg F.
4. Casing: Cast iron, Bronze or Stainless steel, with threaded or companion-flange connections.
5. Impeller: stainless steel.
6. Motor: Single speed.

2.3 HORIZONTALLY MOUNTED, IN-LINE, CLOSE-COUPLED CENTRIFUGAL PUMPS

A. Description: Factory-assembled and -tested, in-line, single-stage, close-coupled, overhung-impeller centrifugal pumps designed for installation with pump and motor shaft mounted horizontal.

B. Capacities and Characteristics: See schedule

C. Pump Construction:

1. Casing:

a. Radially split bronze, brass or cast iron with threaded companion-flange connections for pumps with NPS 2 pipe connections and flanged connections for pumps with NPS 2-1/2 pipe connections.
b. Built to permit servicing of pump internals without disturbing the casing or the suction and discharge piping.
c. Gauge port tappings at suction and discharge nozzles.

2. Impeller: Bronze or brass, statically and dynamically balanced, closed, and keyed to shaft.

3. Shaft and Shaft Sleeve: Steel shaft with deflector, with copper-alloy shaft sleeve. Include water slinger on shaft between motor and seal.
4. Shaft Coupling: Flexible, capable of absorbing torsional vibration and shaft misalignment.
5. Seal: Mechanical, with carbon-steel rotating ring, stainless-steel spring, ceramic seat, and rubber bellows and gasket.
6. Bearings: permanently lubricated ball type.
7. Minimum Working Pressure: 175 psig.
8. Continuous Operating Temperature: 225 deg F.

D. Motor: Single speed, with grease-lubricated ball bearings; resiliently or rigidly mounted to pump casing.

2.4 MOTORS

A. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 220513 "Common Motor Requirements for Plumbing 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.

2.5 CONTROLS

A. Pressure Switches: Electric, adjustable for control of water-supply pump.

1. Type: Water-immersion pressure sensor, for installation in piping.
2. Enclosure: NEMA 250.
3. Operation of Pump: On or off.
4. Transformer: Provide if required.
5. Power Requirement: See schedule.

B. Thermostats: Electric; adjustable for control of hot-water circulation pump.

1. Type: Water-immersion temperature sensor, for installation in piping.
2. Range: 65 to 200 deg F.
3. Enclosure: NEMA 250.
4. Operation of Pump: On or off.
5. Transformer: Provide if required.
6. Power Requirement: 120 V ac.
7. Settings: Start pump at 110 deg F and stop pump at 120 deg F.

C. Timers: Electric, for control of hot-water circulation pump.

1. Type: Programmable, seven-day clock with manual override on-off switch.
2. Enclosure: NEMA 250, suitable for wall mounting.
3. Operation of Pump: On or off.
4. Transformer: Provide if required.
5. Power Requirement: 24 V ac or 120 V ac.
6. Programmable Sequence of Operation: Up to two on-off cycles each day for seven days.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in for domestic-water-piping system to verify actual locations of piping connections before pump installation.

3.2 PUMP INSTALLATION

A. Comply with HI 1.4.

B. Mount pumps in orientation complying with manufacturer's written instructions.

C. Install continuous-thread hanger rods and vibration isolation of size required to support pump weight.

1. Comply with requirements for vibration isolation devices specified in Section 220548.13 "Vibration Controls for Plumbing Piping and Equipment." Fabricate brackets or supports as required.
2. Comply with requirements for hangers and supports specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."

D. Install pressure switches in water-supply piping.

E. Install thermostats in hot-water return piping.

F. Install timers.

3.3 PIPING CONNECTIONS

A. Comply with requirements for piping specified in Section 221116 "Domestic Water Piping." Drawings indicate general arrangement of piping, fittings, and specialties.

B. Where installing piping adjacent to inline, domestic-water pumps, allow space for service and maintenance.

C. Connect domestic-water piping to pumps. Install suction and discharge piping equal to or greater than size of pump nozzles.

1. Install flexible connectors adjacent to pumps in suction and discharge piping of the following pumps:

a. Horizontally mounted, in-line, separately coupled centrifugal pumps.
b. Horizontally mounted, in-line, close-coupled centrifugal pumps.
c. Comply with requirements for flexible connectors specified in Section 221116 "Domestic Water Piping."

D. Install shutoff valve and strainer on suction side of each pump, and check, shutoff, and throttling valves on discharge side of each pump. Install valves same size as connected piping. Comply with requirements for strainers specified in Section 221119 "Domestic Water Piping Specialties." Comply with requirements for valves specified in the following:

1. Section 220523.12 "Ball Valves for Plumbing Piping."
2. Section 220523.13 "Butterfly Valves for Plumbing Piping."
3. Section 220523.14 "Check Valves for Plumbing Piping."
4. Section 220523.15 "Gate Valves for Plumbing Piping."
5. Install pressure gauge and snubber at suction of each pump and pressure gauge and snubber at discharge of each pump. Install at integral pressure-gauge tappings where provided or install pressure-gauge connectors in suction and discharge piping around pumps. Comply with requirements for pressure gauges and snubbers specified in Section 220519 "Meters and Gages for Plumbing Piping."

3.4 CONTROL CONNECTIONS

A. Install control and electrical power wiring to field-mounted control devices.

B. Connect control wiring between temperature controllers and devices.

3.5 IDENTIFICATION

A. Identify system components. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment" for identification of pumps.

3.6 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

C. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

D. Perform tests and inspections with the assistance of a factory-authorized service representative.

E. Tests and Inspections:

1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
2. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

F. Inline, domestic-water pump will be considered defective if it does not pass tests and inspections.

G. Prepare test and inspection reports.

3.7 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.

2. Check piping connections for tightness.
3. Clean strainers on suction piping.
4. Set pressure switches, thermostats, and timers for automatic starting and stopping operation of pumps.
5. Perform the following startup checks for each pump before starting:

    a. Verify bearing lubrication.
    b. Verify that pump is free to rotate by hand and that pump for handling hot liquid is free to rotate with pump hot and cold. If pump is bound or drags, do not operate until cause of trouble is determined and corrected.
    c. Verify that pump is rotating in the correct direction.

6. Prime pump by opening suction valves and closing drains, and prepare pump for operation.
7. Start motor.
8. Open discharge valve slowly.
9. Adjust temperature settings on thermostats.
10. Adjust timer settings.

3.8 ADJUSTING

A. Adjust inline, domestic-water pumps to function smoothly, and lubricate as recommended by manufacturer.

B. Adjust initial temperature set points.

C. Set field-adjustable switches and circuit-breaker trip ranges as indicated.

END OF SECTION 221123.21

SECTION 221316 - SANITARY WASTE AND VENT PIPING

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. Hub-and-spigot, cast-iron soil pipe and fittings.
2. Hubless, cast-iron soil pipe and fittings.
3. PVC pipe and fittings.
4. Specialty pipe fittings.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.4 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.5 FIELD CONDITIONS

A. Interruption of Existing Sanitary Waste Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:

1. Notify Owner no fewer than two days in advance of proposed interruption of sanitary waste service.
2. Do not proceed with interruption of sanitary waste service without Owner's written permission.

1.6 WARRANTY

A. Listed manufacturers to provide labeling and warranty of their respective products.

PART 2 - PRODUCTS

2.1 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.
2. Waste, Force-Main Piping: 50 psig .

2.2 PIPING MATERIALS

A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

B. 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.

2.3 HUB-AND-SPIGOT, CAST-IRON SOIL PIPE AND FITTINGS

A. Pipe and Fittings: ASTM A 74, Service class.

B. Gaskets: ASTM C 564, rubber.

C. Caulking Materials: ASTM B 29, pure lead and oakum or hemp fiber.

2.4 HUBLESS, CAST-IRON SOIL PIPE AND FITTINGS

A. Pipe and Fittings: ASTM A 888 or CISPI 301.

B. CISPI, Hubless-Piping Couplings:

1. Standards: ASTM C 1277 and CISPI 310.
2. Description: Stainless-steel corrugated shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.

C. Cast-Iron, Hubless-Piping Couplings:

1. Standard: ASTM C 1277.
2. Description: Two-piece ASTM A 48/A 48M, cast-iron housing; stainless-steel bolts and nuts; and ASTM C 564, rubber sleeve with integral, center pipe stop.

2.5 PVC PIPE AND FITTINGS

A. 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-sewer" for plastic sewer piping.

B. Solid-Wall PVC Pipe: ASTM D 2665, drain, waste, and vent.

C. PVC Socket Fittings: ASTM D 2665, made to ASTM D 3311, drain, waste, and vent patterns and to fit Schedule 40 pipe.

D. Adhesive Primer: ASTM F 656.

E. Solvent Cement: ASTM D 2564.

2.6 SPECIALTY PIPE FITTINGS

A. Transition Couplings:

1. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.
2. Unshielded, Nonpressure Transition Couplings:
   a. Standard: ASTM C 1173.
   b. Description: Elastomeric, sleeve-type, reducing or transition pattern. Include shear ring and corrosion-resistant-metal tension band and tightening mechanism on each end.
   c. End Connections: Same size as and compatible with pipes to be joined.
   d. Sleeve Materials:
      1) For Cast-Iron Soil Pipes: ASTM C 564, rubber.
      2) For Plastic Pipes: ASTM F 477, elastomeric seal or ASTM D 5926, PVC.
      3) For Dissimilar Pipes: ASTM D 5926, PVC or other material compatible with pipe materials being joined.
3. Shielded, Nonpressure Transition Couplings:
   a. Standard: ASTM C 1460.
   b. Description: Elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.
   c. End Connections: Same size as and compatible with pipes to be joined.
4. Pressure Transition Couplings:
   a. Standard: AWWA C219.
   b. Description: Metal, sleeve-type same size as, with pressure rating at least equal to, and ends compatible with, pipes to be joined.
   c. Center-Sleeve Material: Carbon steel, Stainless steel, Ductile iron or Malleable iron.
   d. Gasket Material: Natural or synthetic rubber.
   e. Metal Component Finish: Corrosion-resistant coating or material.

B. Dielectric Fittings:

1. Dielectric Unions:
   a. Description:
      1) Standard: ASSE 1079.
      2) Pressure Rating: 125 psig minimum at 180 deg F .
      3) End Connections: Solder-joint copper alloy and threaded ferrous.
2. Dielectric Flanges:
   a. Description:
      1) Standard: ASSE 1079.

2) Factory-fabricated, bolted, companion-flange assembly.
3) Pressure Rating: 125 psig minimum at 180 deg F .
4) End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

3. Dielectric-Flange Insulating Kits:

a. Description:

1) Nonconducting materials for field assembly of companion flanges.
2) Pressure Rating: 150 psig .
3) Gasket: Neoprene or phenolic.
4) Bolt Sleeves: Phenolic or polyethylene.
5) Washers: Phenolic with steel backing washers.

4. Dielectric Nipples:

a. Description:

1) Standard: IAPMO PS 66.
2) Electroplated steel nipple.
3) Pressure Rating: 300 psig at 225 deg F .
4) End Connections: Male threaded or grooved.
5) Lining: Inert and noncorrosive, propylene.

PART 3 - EXECUTION

3.1 EARTH MOVING

A. Comply with requirements for excavating, trenching, and backfilling specified in Section 312000 "Earth Moving."

3.2 PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems.

1. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations.
2. Install piping as indicated unless deviations to layout are approved on coordination drawings.

B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

C. 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.

D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

E. Install piping to permit valve servicing.

F. Install piping at indicated slopes.

G. Install piping free of sags and bends.

H. Install fittings for changes in direction and branch connections.

I. Install piping to allow application of insulation.

J. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends.

1. 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.
2. Use long-turn, double Y-branch and 1/8-bend fittings if two fixtures are installed back to back or side by side with common drain pipe.

a. Straight tees, elbows, and crosses may be used on vent lines.

3. Do not change direction of flow more than 90 degrees.
4. Use proper size of standard increasers and reducers if pipes of different sizes are connected.

a. Reducing size of waste piping in direction of flow is prohibited.

K. Lay buried building waste piping beginning at low point of each system.

1. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream.
2. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements.
3. Maintain swab in piping and pull past each joint as completed.

L. Install soil and waste and vent piping at the following minimum slopes unless otherwise indicated:

1. Building Sanitary Waste: 2 percent downward in direction of flow for piping NPS 2 and smaller; 1 percent downward in direction of flow for piping NPS 3 and larger.
2. Horizontal Sanitary Waste Piping: 1 percent downward in direction of flow.
3. Vent Piping: 1 percent down toward vertical fixture vent or toward vent stack.

M. 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/A 21.5.

N. Install aboveground PVC piping according to ASTM D 2665.

O. Install underground PVC piping according to ASTM D 2321.

P. Install engineered soil and waste and vent piping systems as follows:

1. Combination Waste and Vent: Comply with standards of authorities having jurisdiction.

Q. Plumbing Specialties:

1. Install backwater valves in sanitary waster gravity-flow piping.

    a. Comply with requirements for backwater valves specified in Section 221319 "Sanitary Waste Piping Specialties."

2. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers in sanitary waste gravity-flow piping.

    a. Comply with requirements for cleanouts specified in Section 221319 "Sanitary Waste Piping Specialties."

3. Install drains in sanitary waste gravity-flow piping.

    a. Comply with requirements for drains specified in Section 221319 "Sanitary Waste Piping Specialties."

R. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

S. Install sleeves for piping penetrations of walls, ceilings, and floors.

1. Comply with requirements for sleeves specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

T. Install sleeve seals for piping penetrations of concrete walls and slabs.

1. Comply with requirements for sleeve seals specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

U. Install escutcheons for piping penetrations of walls, ceilings, and floors.

1. Comply with requirements for escutcheons specified in Section 220518 "Escutcheons for Plumbing Piping."

3.3 JOINT CONSTRUCTION

A. Join hub-and-spigot, cast-iron soil piping with gasket joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.

B. Join hub-and-spigot, cast-iron soil piping with calked joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for lead-and-oakum calked joints.

C. Join hubless, cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-piping coupling joints.

D. Plastic, Nonpressure-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. PVC Piping: Join according to ASTM D 2855 and ASTM D 2665 appendixes.

3.4 SPECIALTY PIPE FITTING INSTALLATION

A. Transition Couplings:

1. Install transition couplings at joints of piping with small differences in ODs.
2. In Waste Drainage Piping: Shielded, nonpressure transition couplings.

B. Dielectric Fittings:

1. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
2. Dielectric Fittings for NPS 2 and Smaller: Use dielectric nipples or unions.
3. Dielectric Fittings for NPS 2-1/2 to NPS 4: Use dielectric flanges, flange kits or nipples.
4. Dielectric Fittings for NPS 6 and Larger: Use dielectric flange kits.

3.5 VALVE INSTALLATION

A. Comply with requirements in Section 220523.12 "Ball Valves for Plumbing Piping," Section 220523.13 "Butterfly Valves for Plumbing Piping," Section 220523.14 "Check Valves for Plumbing Piping," and Section 220523.15 "Gate Valves for Plumbing Piping" for general-duty valve installation requirements.

B. Shutoff Valves:

1. Install shutoff valve on each sewage pump discharge.
2. Install gate or full-port ball valve for piping NPS 2 and smaller.
3. 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 sewage 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. Floor Drains: Drain outlet backwater valves unless drain has integral backwater valve.
3. Install backwater valves in accessible locations.
4. Comply with requirements for backwater valve specified in Section 221319 "Sanitary Waste Piping Specialties."

3.6 INSTALLATION OF HANGERS AND SUPPORTS

A. Comply with requirements for seismic-restraint devices specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."

B. Comply with requirements for pipe hanger and support devices and installation specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment." and Section 220548.13 "Vibration Controls for Plumbing Piping and Equipment."

1. Install carbon-steel pipe hangers for horizontal piping in noncorrosive environments.
2. Install stainless-steel pipe hangers for horizontal piping in corrosive environments.
3. Install carbon-steel pipe support clamps for vertical piping in noncorrosive environments.
4. Install stainless-steel pipe support clamps for vertical piping in corrosive environments.
5. Vertical Piping: MSS Type 8 or Type 42, clamps.

6. Install individual, straight, horizontal piping runs:

    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.

7. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
8. Base of Vertical Piping: MSS Type 52, spring hangers.

C. Install hangers for cast-iron and copper soil piping, with maximum horizontal spacing and minimum rod diameters, to comply with MSS-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

D. Install hangers for PVC piping, with maximum horizontal spacing and minimum rod diameters, to comply with manufacturer's written instructions, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

E. Support horizontal piping and tubing within 12 inches of each fitting, valve, and coupling.

F. Support vertical runs of cast iron piping to comply with MSS-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

G. Support vertical runs of PVC piping to comply with manufacturer's written instructions, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

3.7 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect soil and waste piping to exterior sanitary sewerage piping. Use transition fitting to join dissimilar piping materials.

C. Connect waste and vent piping to the following:

1. Plumbing Fixtures: Connect waste piping in sizes indicated, but not smaller than required by plumbing code.
2. Plumbing Fixtures and Equipment: Connect atmospheric vent piping in sizes indicated, but not smaller than required by authorities having jurisdiction.
3. Plumbing Specialties: Connect waste and vent piping in sizes indicated, but not smaller than required by plumbing code.
4. Install test tees (wall cleanouts) in conductors near floor and floor cleanouts with cover flush with floor.
5. Install horizontal backwater valves with cleanout cover flush with floor.
6. Comply with requirements for backwater valves, cleanouts and drains specified in Section 221319 "Sanitary Waste Piping Specialties."
7. Equipment: Connect waste piping as indicated.

    a. Provide shutoff valve if indicated and union for each connection.
    b. Use flanges instead of unions for connections NPS 2-1/2 and larger.

D. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.

E. Make connections according to the following unless otherwise indicated:

1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.

3.8 IDENTIFICATION

A. Identify exposed sanitary waste and vent piping.

B. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.9 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 waste and vent 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.

    a. 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 waste and vent piping until it has been tested and approved.

    a. Expose work that was covered or concealed before it was tested.

3. Roughing-in Plumbing Test Procedure: Test waste and vent piping except outside leaders on completion of roughing-in.

    a. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water.
    b. From 15 minutes before inspection starts to completion of inspection, water level must not drop.
    c. Inspect joints for leaks.

4. Finished Plumbing Test Procedure: After plumbing fixtures have been set and traps filled with water, test connections and prove they are gastight and watertight.

    a. Plug vent-stack openings on roof and building drains where they leave building. Introduce air into piping system equal to pressure of 1-inch wg.
    b. Use U-tube or manometer inserted in trap of water closet to measure this pressure.
    c. Air pressure must remain constant without introducing additional air throughout period of inspection.
    d. Inspect plumbing fixture connections for gas and water leaks.

5. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
6. Prepare reports for tests and required corrective action.

7. Cap and subject piping to static-water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials.

    a. Isolate test source and allow to stand for four hours.
    b. Leaks and loss in test pressure constitute defects that must be repaired.

8. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
9. Prepare reports for tests and required corrective action.

3.10 CLEANING AND PROTECTION

A. Clean interior of piping. Remove dirt and debris as work progresses.

B. Protect sanitary waste and vent piping during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.

C. Place plugs in ends of uncompleted piping at end of day and when work stops.

D. Exposed PVC Piping: Protect plumbing vents exposed to sunlight with two coats of water-based latex paint.

E. Repair damage to adjacent materials caused by waste and vent piping installation.

3.11 PIPING SCHEDULE

A. Flanges and unions may be used on aboveground pressure piping unless otherwise indicated.

B. Aboveground, soil, waste and vent piping 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 and hubless,; CISPI hubless-piping couplings; and coupled joints.
3. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints. To be installed in non-return air plenum spaces.
4. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.

C. Underground, soil, waste, and vent piping shall be any of the following:

1. Service class, cast-iron soil piping; gaskets; and gasketed joints.
2. Hubless, cast-iron soil pipe and fittings; CISPI cast-iron hubless-piping couplings; and coupled joints.
3. Solid wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
4. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.

END OF SECTION 221316

SECTION 221319 - SANITARY WASTE PIPING SPECIALTIES

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. Backwater valves.
2. Cleanouts.
3. Miscellaneous sanitary drainage piping specialties.

B. Related Requirements:

1. Section 076200 "Sheet Metal Flashing and Trim" for metal roof flashing assemblies.
2. Section 077200 "Roof Accessories" for preformed flashings.
3. Section 078413 "Penetration Firestopping" for through-penetration firestop assemblies.
4. Section 221323 "Sanitary Waste Interceptors" for metal and concrete interceptors outside the building, oil interceptors, and solids interceptors.
5. Section 221423 "Storm Drainage Piping Specialties" for trench drains for storm water, channel drainage systems for storm water, roof drains, and catch basins.
6. Section 334200 "Stormwater Conveyance" for storm drainage piping and piping specialties outside the building.

1.3 DEFINITIONS

A. ABS: Acrylonitrile butadiene styrene.

B. PVC: Polyvinyl chloride.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings:

1. Show fabrication and installation details for frost-resistant vent terminals.

1.5 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For sanitary waste piping specialties to include in emergency, operation, and maintenance manuals.

PART 2 - PRODUCTS

2.1 ASSEMBLY DESCRIPTIONS

A. Sanitary waste piping specialties shall bear label, stamp, or other markings of specified testing agency.

B. Comply with NSF 14 for plastic sanitary waste piping specialty components.

2.2 BACKWATER VALVES

A. Horizontal, Cast-Iron Backwater Valves:

1. Standard: ASME A112.14.1.
2. Size: Same as connected piping.
3. Body: Cast iron.
4. Cover: Cast iron with bolted or threaded access check valve.
5. End Connections: Hub and spigot or hubless.
6. Type Check Valve: Removable, bronze, swing check, factory assembled or field modified to hang open for airflow unless subject to backflow condition.
7. Extension: ASTM A74, Service Class; full-size, cast-iron, soil-pipe extension to field-installed cleanout at floor; replaces backwater valve cover.

B. Drain-Outlet Backwater Valves:

1. Size: Same as floor drain outlet.
2. Body: Cast iron or bronze; made for vertical installation in bottom outlet of floor drain.
3. Check Valve: Removable ball float.
4. Inlet: Threaded.
5. Outlet: Threaded or spigot.

C. Horizontal, Plastic Backwater Valves:

1. Size: Same as connected piping.
2. Body: PVC.
3. Cover: Same material as body with threaded access to check valve.
4. Check Valve: Removable swing check.
5. End Connections: Socket type.

2.3 CLEANOUTS

A. Cast-Iron Exposed Cleanouts:

1. Standard: ASME A112.36.2M.
2. Size: Same as connected drainage piping
3. Body Material: Hub-and-spigot, cast-iron soil pipe T-branch or Hubless, cast-iron soil pipe test tee as required to match connected piping.
4. Closure: Countersunk, brass or cast-iron plug.

5. Closure Plug Size: Same as or not more than one size smaller than cleanout size.

B. Stainless Steel Exposed Cleanouts:

1. Standard: ASME A112.3.1.
2. Size: Same as connected drainage piping.
3. Body Material: Stainless steel tee with side cleanout as required to match connected piping.
4. Closure: Stainless steel plug with seal.

C. Cast-Iron Exposed Floor Cleanouts:

1. Standard: ASME A112.36.2M for adjustable housing cleanout.
2. Size: Same as connected branch.
3. Type: Adjustable housing.
4. Body or Ferrule: Cast iron.
5. Clamping Device: Not required.
6. Outlet Connection: Inside calk, Spigot or Threaded.
7. Closure: Brass plug with straight threads and gasket or Cast-iron plug.
8. Adjustable Housing Material: Cast iron with threads, setscrews or other device.
9. Frame and Cover Material and Finish: Nickel-bronze, copper alloy, Rough bronze or Stainless steel.
10. Frame and Cover Shape: See schedule
11. Top-Loading Classification: See schedule.
12. Riser: ASTM A74, Service Class, cast-iron drainage pipe fitting and riser to cleanout.

D. Stainless Steel Exposed Floor Cleanouts:

1. Standards: ASME A112.3.1.
2. Size: Same as connected branch.
3. Housing: Type 304 stainless steel or Type 316 stainless steel.
4. Closure: Stainless steel with seal.
5. Riser: ASTM A74, Service Class, stainless steel or cast-iron drainage pipe fitting and riser to cleanout.
6. Body or Ferrule: Stainless steel.
7. Clamping Device: Not required.
8. Outlet Connection: Inside caulk, Spigot or Threaded.
9. Adjustable Housing Material: Cast iron with threads, setscrews or other device.
10. Frame and Cover Material and Finish: Stainless steel.
11. Frame and Cover Shape: See schedules.
12. Top-Loading Classification: Light Duty.

E. Cast-Iron Wall Cleanouts:

1. Standard: ASME A112.36.2M. Include wall access.
2. Size: Same as connected drainage piping.
3. Body: Hub-and-spigot, cast-iron soil pipe T-branch or Hubless, cast-iron soil pipe test tee as required to match connected piping.
4. Closure Plug:

    a. Brass or Cast iron.
    b. Countersunk head.
    c. Drilled and threaded for cover attachment screw.
    d. Size: Same as or not more than one size smaller than cleanout size.

5. Wall Access, Cover Plate: Round, flat, chrome-plated brass or stainless steel cover plate with screw.

6. Wall Access, Frame and Cover: Round, nickel-bronze, copper-alloy, or stainless steel wall-installation frame and cover.

2.4 MISCELLANEOUS SANITARY DRAINAGE PIPING SPECIALTIES

A. Open Drains:

1. Description: Shop or field fabricate from ASTM A74, Service Class, hub-and-spigot, cast-iron soil-pipe fittings. Include P-trap, hub-and-spigot riser section; and where required, increaser fitting joined with ASTM C564 rubber gaskets.
2. Size: Same as connected waste piping with increaser fitting of size indicated.

B. Deep-Seal Traps:

1. Description: Cast-iron or bronze casting, with inlet and outlet matching connected piping and cleanout trap-seal primer valve connection.
2. Size: Same as connected waste piping.

   a. NPS 2: 4-inch minimum water seal.
   b. NPS 2-1/2 and Larger: 5-inch minimum water seal.

C. Floor-Drain, Inline Trap Seal:

1. Description: Inline floor drain trap seal, forming a physical barrier to slow trap evaporation while not impeding flow from drain.
2. Material: Polymer.
3. Standard: Tested and certified in accordance with ASSE 1072.
4. Listing: ICC-ES or IAPMO listed.
5. Size: Same as floor drain outlet or strainer throat.

D. Air-Gap Fittings:

1. Standard: ASME A112.1.2, for fitting designed to ensure fixed, positive air gap between installed inlet and outlet piping.
2. Body: Bronze or cast iron.
3. Inlet: Opening in top of body.
4. Outlet: Larger than inlet.
5. Size: Same as connected waste piping and with inlet large enough for associated indirect waste piping.

E. Sleeve Flashing Device:

1. Description: Manufactured, cast-iron fitting, with clamping device that forms sleeve for pipe floor penetrations of floor membrane. Include galvanized-steel pipe extension in top of fitting that will extend 2 inches above finished floor and galvanized-steel pipe extension in bottom of fitting that will extend through floor slab.
2. Size: As required for close fit to riser or stack piping.

F. Vent Caps:

1. Description: Cast-iron body with threaded or hub inlet and vandal-proof design. Include vented hood and setscrews to secure to vent pipe.
2. Size: Same as connected stack vent or vent stack.

G. Expansion Joints:

1. Standard: ASME A112.6.4.
2. Body: Cast iron with bronze sleeve, packing, and gland.
3. End Connections: Matching connected piping.
4. Size: Same as connected soil, waste, or vent piping.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install backwater valves in building drain piping.

1. For interior installation, provide cleanout deck plate flush with floor and centered over backwater valve cover, and of adequate size to remove valve cover for servicing.

B. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:

1. Size same as drainage piping up to NPS 4. Use NPS 4 for larger drainage piping unless larger cleanout is indicated.
2. Locate at each change in direction of piping greater than 45 degrees.
3. Locate at minimum intervals of 100 feet.
4. Locate at base of each vertical soil and waste stack.

C. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.

D. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.

E. Assemble open drain fittings and install with top of hub 2 inches above floor.

F. Install deep-seal traps on floor drains and other waste outlets, if indicated.

G. Install floor-drain, trap-seal primer fittings on inlet to floor drains that require trap-seal primer connection.

1. Exception: Fitting may be omitted if trap has trap-seal primer connection.
2. Size: Same as floor drain inlet.

H. Install air-gap fittings on draining-type backflow preventers and on indirect-waste piping discharge into sanitary drainage system.

I. Install sleeve and sleeve seals with each riser and stack passing through floors with waterproof membrane.

J. Install vent caps on each vent pipe passing through roof.

K. Install expansion joints on vertical stacks and conductors. Position expansion joints for easy access and maintenance.

L. Install wood-blocking reinforcement for wall-mounting-type specialties.

M. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is indicated.

3.2 PIPING CONNECTIONS

A. Comply with requirements in Section 221316 "Sanitary Waste and Vent Piping" for piping installation requirements. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to equipment, to allow service and maintenance.

3.3 LABELING AND IDENTIFYING

A. 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.

1. Nameplates and signs are specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.4 PROTECTION

A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.

B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION 221319

SECTION 221319.13 - SANITARY DRAINS

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. Floor drains.
2. Floor sinks.

1.3 DEFINITIONS

A. ABS: Acrylonitrile-butadiene styrene.

B. FRP: Fiberglass-reinforced plastic.

C. HDPE: High-density polyethylene.

D. PE: Polyethylene.

E. PP: Polypropylene.

F. PVC: Polyvinyl chloride.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 DRAIN ASSEMBLIES

A. Sanitary drains shall bear label, stamp, or other markings of specified testing agency.

B. Comply with NSF 14 for plastic sanitary piping specialty components.

2.2 FLOOR DRAINS

A. Cast-Iron Floor Drains:

1. Standard: ASME A112.6.3.
2. Pattern: Floor drain.
3. Body Material: Gray iron.
4. Seepage Flange: Not required.
5. Anchor Flange: Not required.
6. Clamping Device: Not required.
7. Outlet: Bottom.
8. Backwater Valve: Not required.
9. Coating on Interior and Exposed Exterior Surfaces: Not required.
10. Sediment Bucket: Not required.
11. Top or Strainer Material: See schedule.
12. Top of Body and Strainer Finish: See schedule
13. Top Shape: Square.
14. Top Loading Classification: See schedule
15. Funnel: Not required.
16. Inlet Fitting: Not required.
17. Trap Material: See schedule.
18. Trap Pattern: See schedule.
19. Trap Features: Not required.
20. Trap Pattern: Deep-seal P-trap or Standard P-trap.

B. Cast-Iron Floor Sinks:

1. Standard: ASME A112.6.7.
2. Pattern: Floor drain.
3. Body Material: Cast iron.
4. Anchor Flange: Not required.
5. Clamping Device: Not required.
6. Outlet: Bottom, no-hub connection.
7. Coating on Interior Surfaces: Not required.
8. Sediment Bucket: See schedule.
9. Internal Strainer: Dome.
10. Internal Strainer Material: Aluminum.
11. Top Grate Material: Cast iron, loose.
12. Top of Body and Grate Finish: See schedule.
13. Top Shape: Square.
14. Top Loading Classification: No traffic.
15. Funnel: Not required.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install floor drains at low points of surface areas to be drained. Set grates of drains flush with finished floor, unless otherwise indicated.

1. Position floor drains for easy access and maintenance.
2. Set floor drains below elevation of surrounding finished floor to allow floor drainage.
3. Set with grates depressed according to the following drainage area radii:

   a. Radius, 30 Inches or Less: Equivalent to 1 percent slope, but not less than 1/4-inch total depression.
   b. Radius, 30 to 60 Inches; Equivalent to 1 percent slope.

c. Radius, 60 Inches or Larger: Equivalent to 1 percent slope, but not greater than 1-inch total depression.

4. Install floor-drain flashing collar or flange, so no leakage occurs between drain and adjoining flooring.

a. Maintain integrity of waterproof membranes where penetrated.

5. Install individual traps for floor drains connected to sanitary building drain, unless otherwise indicated.

B. Install open drain fittings with top of hub 1 inch above floor.

3.2 CONNECTIONS

A. Comply with requirements in Section 221316 "Sanitary Waste and Vent Piping" for piping installation requirements. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Comply with requirements in Section 221319 "Sanitary Waste Piping Specialties" for backwater valves, air admittance devices and miscellaneous sanitary drainage piping specialties.

C. Comply with requirements in Section 221323 "Sanitary Waste Interceptors" for grease interceptors, grease-removal devices, oil interceptors, sand interceptors, and solid interceptors.

D. Install piping adjacent to equipment to allow service and maintenance.

E. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."

F. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.3 LABELING AND IDENTIFYING

A. 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 Section 220553 "Identification for Plumbing Piping and Equipment."

3.4 PROTECTION

A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.

B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION 221319.13

SECTION 221423 - STORM DRAINAGE PIPING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Metal roof drains.
2. Miscellaneous storm drainage piping specialties.
3. Cleanouts.

B. Related Requirements:

1. Section 076200 "Sheet Metal Flashing and Trim" for penetrations of roofs.
2. Section 078413 "Penetration Firestopping" for firestopping roof penetrations.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.4 QUALITY ASSURANCE

A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.

PART 2 - PRODUCTS

2.1 METAL ROOF DRAINS

A. Cast-Iron, Large-Sump, General-Purpose Roof Drains:

1. Standard: ASME A112.6.4.
2. Body Material: Cast iron.
3. Dimension of Body: Nominal 14-to 16-inch diameter.
4. Combination Flashing Ring and Gravel Stop: Not required.
5. Flow-Control Weirs: Not required.
6. Outlet: Bottom.
7. Outlet Type: No hub.
8. Extension Collars: See schedule.
9. Underdeck Clamp: See schedule.
10. Expansion Joint: Not required.

11. Sump Receiver Plate: See schedule.
12. Dome Material: See schedule.
13. Perforated Gravel Guard: Not required.
14. Vandal-Proof Dome: Not required.
15. Water Dam: See schedule.

B. Cast-Iron, Medium-Sump, General-Purpose Roof Drains:

1. Standard: ASME A112.6.4.
2. Body Material: Cast iron.
3. Dimension of Body: 8- to 12-inch diameter.
4. Combination Flashing Ring and Gravel Stop: Not required.
5. Flow-Control Weirs: Not required.
6. Outlet: Bottom.
7. Outlet Type: No hub.
8. Extension Collars: See schedule.
9. Underdeck Clamp: See schedule.
10. Expansion Joint: Not required.
11. Sump Receiver Plate: See schedule.
12. Dome Material: See schedule.
13. Wire Mesh: Not required.
14. Perforated Gravel Guard: Not required.
15. Vandal-Proof Dome: Not required.
16. Water Dam: See schedule.

2.2 MISCELLANEOUS STORM DRAINAGE PIPING SPECIALTIES

A. Metal Downspout Nozzles:

1. Description: Nozzle with wall flange and mounting holes to cover rough opening and serve as anchor..
2. Size: Same as connected downspout.
3. Material: Cast bronze or nickel bronze nozzle and flange.
4. Piping Connection Type: Threaded, No-hub or Slip on.
5. Opening Protection: None.

2.3 CLEANOUTS

A. Cast-Iron Exposed Cleanouts:

1. Standard: ASME A112.36.2M.
2. Size: Same as connected branch.
3. Body Material: Hub-and-spigot, cast-iron soil pipe T-branch or No-hub, cast-iron soil pipe test tee as required to match connected piping.
4. Closure: Countersunk, brass or cast-iron plug.
5. Closure Plug Size: Same as, or not more than, one size smaller than cleanout size.

B. Cast-Iron Exposed Floor Cleanouts:

1. Standard: ASME A112.36.2M.
2. Size: Same as connected branch.
3. Type: Adjustable housing.
4. Body or Ferrule: Cast iron.
5. Clamping Device: Not required.
6. Outlet Connection: No hub, Hub with inside caulk, Hub with gasket or Threaded.

7. Closure: Brass plug with straight threads and gasket, Brass plug with tapered threads or Cast-iron plug.
8. Adjustable Housing Material: Cast iron with threads, setscrews or other device.
9. Frame and Cover Material and Finish: See schedule.
10. Frame and Cover Shape: See schedule.
11. Top Loading Classification: Light Duty.
12. Riser: ASTM A74, Service class, cast-iron drainage pipe fitting and riser to cleanout.

C. Cast-Iron Wall Cleanouts:

1. Standard: ASME A112.36.2M. Include wall access.
2. Size: Same as connected drainage piping.
3. Body: Hub-and-spigot, cast-iron soil pipe T-branch or No-hub, cast-iron soil pipe test tee as required to match connected piping.
4. Closure Plug:

   a. Brass or Cast iron.
   b. Countersunk head.
   c. Drilled and threaded for cover attachment screw.
   d. Size: Same as, or not more than, one size smaller than cleanout size.

5. Wall Access, Cover Plate: Round, flat, chrome-plated brass or stainless steel cover plate with screw.
6. Wall Access, Frame and Cover: Round, nickel-bronze, copper-alloy, or stainless steel wall-installation frame and cover.

D. Test Tees:

1. Standard: ASME A112.36.2M and ASTM A74, ASTM A888, or CISPI 301.
2. Size: Same as connected drainage piping.
3. Body Material: Hub-and-spigot, cast-iron soil-pipe T-branch or no-hub, cast-iron soil-pipe test tee as required to match connected piping.
4. Closure Plug: Countersunk, brass.
5. Closure Plug Size: Same as, or not more than, one size smaller than cleanout size.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install roof drains at low points of roof areas in accordance with roof membrane manufacturer's written installation instructions.

1. Install flashing collar or flange of roof drain to prevent leakage between drain and adjoining roofing. Maintain integrity of waterproof membranes where penetrated.
2. Position roof drains for easy access and maintenance.

B. Install downspout nozzles at exposed bottom of conductors where they spill onto grade.

C. Install cleanouts in aboveground piping and building drain piping in accordance with the following instructions unless otherwise indicated:

1. Use cleanouts the same size as drainage piping up to NPS 4. Use NPS 4 for larger drainage piping unless larger cleanout is indicated.
2. Locate cleanouts at each change in direction of piping greater than 45 degrees.

3. Locate cleanouts at minimum intervals of 100 feet for piping.
4. Locate cleanouts at base of each vertical storm piping conductor.

D. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.

E. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.

F. Install test tees in vertical conductors and near floor.

G. Install wall cleanouts in vertical conductors. Install access door in wall if indicated.

H. Install through-penetration firestop assemblies for penetrations of fire- and smoke-rated assemblies.

1. Comply with requirements in Section 078413 "Penetration Firestopping."

3.2 CONNECTIONS

A. Comply with requirements for piping specified in Section 221413 "Facility Storm Drainage Piping." Drawings indicate general arrangement of piping, fittings, and specialties.

3.3 INSTALLATION OF FLASHING

A. Fabricate flashing from single piece of metal unless large pans, sumps, or other drainage shapes are required.

B. Install sheet flashing on pipes, sleeves, and specialties passing through or embedded in floors and roofs with waterproof membrane.

C. Set flashing on floors and roofs in solid coating of bituminous cement.

D. Secure flashing into sleeve and specialty clamping ring or device.

3.4 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 221423

SECTION 221513 - GENERAL-SERVICE COMPRESSED-AIR PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes piping and related specialties for general-service compressed-air systems:

1. Pipes, tubes, and fittings.
2. Joining materials.
3. Valves.
4. Dielectric fittings.
5. Flexible pipe connectors.
6. Specialties.
7. Quick couplings.
8. Hose assemblies.

B. Related Sections include the following:

1. Section 221519 "General-Service Packaged Air Compressors and Receivers" for general-service air compressors and accessories.

1.3 DEFINITIONS

A. ABS: Acrylonitrile-butadiene-styrene plastic.

B. CR: Chlorosulfonated polyethylene synthetic rubber.

C. EPDM: Ethylene-propylene-diene terpolymer rubber.

D. HDPE: High-density polyethylene plastic.

E. NBR: Acrylonitrile-butadiene rubber.

F. PE: Polyethylene plastic.

G. PVC: Polyvinyl chloride plastic.

H. High-Pressure Compressed-Air Piping: System of compressed-air piping and specialties operating at pressures between 150 and 200 psig.

I. Low-Pressure Compressed-Air Piping: System of compressed-air piping and specialties operating at pressures of 150 psig or less.

1.4 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Compressed-air piping and support and installation shall withstand effects of seismic events determined according to SEI/ASCE 7, "Minimum Design Loads for Buildings and Other Structures."

1.5 ACTION SUBMITTALS

A. Product Data: For the following:

1. Plastic pipes, fittings, and valves.
2. Dielectric fittings.
3. Flexible pipe connectors.
4. Safety valves.
5. Pressure regulators. Include rated capacities and operating characteristics.
6. Automatic drain valves.
7. Filters. Include rated capacities and operating characteristics.
8. Lubricators. Include rated capacities and operating characteristics.
9. Quick couplings.
10. Hose assemblies.

1.6 INFORMATIONAL SUBMITTALS

A. Brazing and welding certificates.

B. Qualification Data: For installers.

C. Field quality-control test reports.

1.7 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For general-service compressed-air piping specialties to include in emergency, operation, and maintenance manuals.

1.8 QUALITY ASSURANCE

A. Installer Qualifications:

1. Extruded-Tee Outlet Procedure: Qualify operators according to training provided by T-DRILL Industries Inc., for making branch outlets.
2. Pressure-Seal Joining Procedure for Copper Tubing: Qualify operators according to training provided by Viega; Plumbing and Heating Systems.
3. Pressure-Seal Joining Procedure for Steel Piping. Qualify operators according to training provided by Victaulic Company.
4. Joining Procedures for Aluminum Piping Systems: Qualify installers according to training provided by manufacturers.

B. Brazing: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications," or to AWS B2.2, "Standard for Brazing Procedure and Performance Qualification."

C. Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX.

D. ASME Compliance:

1. Comply with ASME B31.1, "Power Piping," for high-pressure compressed-air piping.
2. Comply with ASME B31.3, "Process Piping," for high- and low-pressure compressed-air piping.
3. Comply with ASME B31.9, "Building Services Piping," for low-pressure compressed-air piping.

1.9 PROJECT CONDITIONS

A. Interruption of Existing Compressed-Air Service: Do not interrupt compressed-air service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary compressed-air service according to requirements indicated:

1. Notify Owner no fewer than two days in advance of proposed interruption of compressed-air service.
2. Do not proceed with interruption of compressed-air service without Owner's written permission.

PART 2 - PRODUCTS

2.1 PIPES, TUBES, AND FITTINGS

A. Copper Tube: ASTM B88, Type K or L seamless, drawn-temper, water tube.

1. Wrought-Copper Fittings: ASME B16.22, solder-joint pressure type or MSS SP-73, wrought copper with dimensions for brazed joints.
2. Cast-Copper-Alloy Flanges: ASME B16.24, Class 150 or 300.
3. Copper Unions: ASME B16.22 or MSS SP-123.
4. Press-Type Fittings, NPS 2 and Smaller: Wrought-copper fitting with EPDM O-ring seal in each end.
5. Press-Type Fittings, NPS 2-1/2 to NPS 4: Bronze fitting with stainless-steel grip ring and EPDM O-ring seal in each end.
6. Extruded-Tee Outlets: Procedure for making branch outlets in copper tube according to ASTM F2014.
7. Grooved-End Fittings and Couplings:
   a. Grooved-End Fittings: ASTM B75, copper tube or ASTM B584, bronze castings.
   b. Couplings: Copper-tube dimensions and design similar to AWWA C606. Include ferrous housing sections, gasket suitable for compressed air, and bolts and nuts. Provide EDPM gasket for oil-free compressed air. Provide NBR gasket if compressed air contains oil or oil vapor.

2.2 JOINING MATERIALS

A. Pipe-Flange Gasket Materials: Suitable for compressed-air 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.

B. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.

C. Solder Filler Metals: ASTM B32, lead-free alloys. Include water-flushable flux according to ASTM B813.

D. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated.

E. 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.

2.3 VALVES

A. Metal Ball, Butterfly, Check, and Gate Valves: Comply with requirements in Section 220523.12 "Ball Valves for Plumbing Piping," Section 220523.13 "Butterfly Valves for Plumbing Piping," Section 220523.14 "Check Valves for Plumbing Piping," and Section 220523.15 "Gate Valves for Plumbing Piping."

2.4 DIELECTRIC FITTINGS

A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.

B. Dielectric Unions:

1. Description:

    a. Standard: ASSE 1079.
    b. Pressure Rating: 125 psig minimum at 180 deg F.
    c. End Connections: Solder-joint copper alloy and threaded ferrous.

C. Dielectric Flanges:

1. Description:

    a. Standard: ASSE 1079.
    b. Factory-fabricated, bolted, companion-flange assembly.
    c. Pressure Rating: 125 psig minimum at 180 deg F.
    d. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

D. Dielectric-Flange Insulating Kits:

1. Description:

    a. Nonconducting materials for field assembly of companion flanges.
    b. Pressure Rating: 150 psig.
    c. Gasket: Neoprene or phenolic.
    d. Bolt Sleeves: Phenolic or polyethylene.

e. Washers: Phenolic with steel backing washers.

2.5 FLEXIBLE PIPE CONNECTORS

A. Bronze-Hose Flexible Pipe Connectors: Corrugated-bronze tubing with bronze wire-braid covering and ends brazed to inner tubing.

1. Working-Pressure Rating: 200 psig minimum.
2. End Connections, NPS 2 and Smaller: Threaded copper pipe or plain-end copper tube.
3. End Connections, NPS 2-1/2 and Larger: Flanged copper alloy.

B. Stainless-Steel-Hose Flexible Pipe Connectors: Corrugated-stainless-steel tubing with stainless-steel wire-braid covering and ends welded to inner tubing.

1. Working-Pressure Rating: 200 psig minimum.
2. End Connections, NPS 2 and Smaller: Threaded steel pipe nipple.
3. End Connections, NPS 2-1/2 and Larger: Flanged steel nipple.

2.6 SPECIALTIES

A. Safety Valves: ASME Boiler and Pressure Vessel Code: Section VIII, "Pressure Vessels," construction; National Board certified, labeled, and factory sealed; constructed of bronze body with poppet-type safety valve for compressed-air service.

1. Pressure Settings: Higher than discharge pressure and same or lower than receiver pressure rating.

B. Air-Main Pressure Regulators: Bronze body, direct acting, spring-loaded manual pressure-setting adjustment, and rated for 250-psig inlet pressure, unless otherwise indicated.

1. Type: Pilot operated.

C. Air-Line Pressure Regulators: Diaphragm or pilot operated, bronze body, direct acting, spring-loaded manual pressure-setting adjustment, and rated for 200-psig minimum inlet pressure, unless otherwise indicated.

D. Air-Line Pressure Regulators: Diaphragm operated, aluminum alloy or plastic body, direct acting, spring-loaded manual pressure-setting adjustment, and rated for 200-psig minimum inlet pressure, unless otherwise indicated.

E. Automatic Drain Valves: Stainless-steel body and internal parts, rated for 200-psig minimum working pressure, capable of automatic discharge of collected condensate. Include mounting bracket if wall mounting is indicated.

F. Coalescing Filters: Coalescing type with activated carbon capable of removing water and oil aerosols; with color-change dye to indicate when carbon is saturated and warning light to indicate when selected maximum pressure drop has been exceeded. Include mounting bracket if wall mounting is indicated.

G. Mechanical Filters: Two-stage, mechanical-separation-type, air-line filters. Equip with deflector plates, resin-impregnated-ribbon-type filters with edge filtration, and drain cock. Include mounting bracket if wall mounting is indicated.

H. Air-Line Lubricators: With drip chamber and sight dome for observing oil drop entering air stream; with oil-feed adjustment screw and quick-release collar for easy bowl removal. Include mounting bracket if wall mounting is indicated.

1. Provide with automatic feed device for supplying oil to lubricator.

2.7 QUICK COUPLINGS

A. General Requirements for Quick Couplings: Assembly with locking-mechanism feature for quick connection and disconnection of compressed-air hose.

B. Automatic-Shutoff Quick Couplings: Straight-through brass body with O-ring or gasket seal and stainless-steel or nickel-plated-steel operating parts.

1. Socket End: With one-way valve and threaded inlet for connection to piping or threaded hose fitting.
2. Plug End: Flow-sensor-bleeder, check-valve type with barbed outlet for attaching hose.

C. Valveless Quick Couplings: Straight-through brass body with stainless-steel or nickel-plated-steel operating parts.

1. Socket End: With O-ring or gasket seal, without valve, and with barbed inlet for attaching hose.
2. Plug End: With barbed outlet for attaching hose.

2.8 HOSE ASSEMBLIES

A. Description: Compatible hose, clamps, couplings, and splicers suitable for compressed-air service, of nominal diameter indicated, and rated for 300-psig minimum working pressure, unless otherwise indicated.

1. Hose: Reinforced single or double wire-braid, CR-covered hose for compressed-air service.
2. Hose Clamps: Stainless-steel clamps or bands.
3. Hose Couplings: Two-piece, straight-through, threaded brass or stainless-steel O-ring or gasket-seal swivel coupling with barbed ends for connecting two sections of hose.
4. Hose Splicers: One-piece, straight-through brass or stainless-steel fitting with barbed ends for connecting two sections of hose.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

A. Compressed-Air Piping between Air Compressors and Receivers: Use one of the following piping materials for each size range:
1. NPS 2-1/2 to NPS 4: Type K or L, copper tube; wrought-copper fittings; and brazed joints.
2. NPS 2-1/2 to NPS 4: Type K or L, copper tube; grooved-end copper fittings; couplings; and grooved joints.

B. Low-Pressure Compressed-Air Distribution Piping: Use one of the following piping materials for each size range:

1. NPS 2-1/2 to NPS 4: Type K or L, copper tube; wrought-copper fittings; and brazed joints.
2. NPS 2-1/2 to NPS 4: Type K or L, copper tube; grooved-end copper fittings; couplings; and grooved joints.

C. High-Pressure Compressed-Air Distribution Piping: Use one of the following piping materials for each size range:

1. NPS 2-1/2 to NPS 4: Type K or L, copper tube; wrought-copper fittings; and brazed joints.
2. NPS 2-1/2 to NPS 4: Type K or L, copper tube; grooved-end copper fittings; couplings; and grooved joints.

D. Drain Piping: Use one of the following piping materials:

1. NPS 2 and Smaller: Type M copper tube; wrought-copper fittings; and brazed or soldered joints.

3.2 VALVE APPLICATIONS

A. Metal General-Duty Valves: Comply with requirements and use valve types specified in "Valve Applications" Articles in Section 220523.12 "Ball Valves for Plumbing Piping," Section 220523.13 "Butterfly Valves for Plumbing Piping," Section 220523.14 "Check Valves for Plumbing Piping," and Section 220523.15 "Gate Valves for Plumbing Piping," according to the following:

1. Low-Pressure Compressed Air: Valve types specified for low-pressure compressed air.
2. High-Pressure Compressed Air: Valve types specified for medium-pressure compressed air.
3. Equipment Isolation NPS 2 and Smaller: Safety-exhaust, copper-alloy ball valve with exhaust vent and pressure rating at least as great as piping system operating pressure.
4. Grooved-end valves may be used with grooved-end piping and grooved joints.

B. General-Duty Valves for Aluminum Piping System: Provide valves, made by piping system manufacturer, that are compatible with piping.

1. Ball Valves, NPS 2 and Smaller: NPT threaded ends, or push-connect bite ring ends.
2. Butterfly Valves, NPS 2-1/2 and Larger: Tube to tube, with two roll-groove end couplings.

3.3 PIPING INSTALLATION, GENERAL

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of compressed-air piping. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, air-compressor sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

B. Install piping concealed from view and protected from physical contact by building occupants, unless otherwise indicated and except in equipment rooms and service areas.

C. 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 otherwise indicated.

D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal and to coordinate with other services occupying that space.

E. Install piping adjacent to equipment and machines to allow service and maintenance.

F. Install air and drain piping with 1 percent slope downward in direction of flow.

G. Install nipples, flanges, unions, transition and special fittings, and valves with pressure ratings same as or higher than system pressure rating, unless otherwise indicated.

H. Equipment and Specialty Flanged Connections:

1. Use steel companion flange with gasket for connection to steel pipe.
2. Use cast-copper-alloy companion flange with gasket and brazed or soldered joint for connection to copper tube. Do not use soldered joints for connection to air compressors or to equipment or machines producing shock or vibration.

I. Flanged joints may be used instead of specified joint for any piping or tubing system.

J. Extended-tee outlets with brazed branch connection may be used for copper tubing, within extruded-tee connection diameter to run tube diameter ratio for tube type, according to Extruded Tee Connections Sizes and Wall Thickness for Copper Tube (Inches) Table in ASTM F2014.

K. Install eccentric reducers where compressed-air piping is reduced in direction of flow, with bottoms of both pipes and reducer fitting flush.

L. Install branch connections to compressed-air mains from top of main. Provide drain leg and drain trap at end of each main and branch and at low points.

M. Install thermometer and pressure gage on discharge piping from each air compressor and on each receiver. Comply with requirements in Section 220519 "Meters and Gages for Plumbing Piping."

N. Install piping to permit valve servicing.

O. Install piping free of sags and bends.

P. Install fittings for changes in direction and branch connections.

Q. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

R. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

S. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 220518 "Escutcheons for Plumbing Piping."

3.4 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 pipe 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 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.

D. Welded Joints for Steel Piping: Join according to AWS D10.12/D10.12M.

E. Brazed Joints for Copper Tubing: Join according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter.

F. Soldered Joints: Apply ASTM B813, water-flushable flux, unless otherwise indicated, to tube end. Join according to ASTM B828 or CDA's "Copper Tube Handbook."

G. Extruded-Tee Outlets for Copper Tubing: Form branches according to ASTM F2014, with tools recommended by procedure manufacturer, and using operators qualified according to Part 1 "Quality Assurance" Article.

H. Flanged Joints: Use asbestos-free, nonmetallic gasket suitable for compressed air. Join flanges with gasket and bolts according to ASME B31.9 for bolting procedure.

I. Grooved Joints: Assemble couplings with housing, gasket, lubricant, and bolts. Join according to AWWA C606 for grooved joints. Do not apply lubricant to prelubricated gaskets.

J. Pressure-Sealed Joints: Join with tools recommended by fitting manufacturer, using operators qualified according to Part 1 "Quality Assurance" Article.

K. Dissimilar Metal Piping Material Joints: Use dielectric fittings.

3.5 VALVE INSTALLATION

A. General-Duty Valves: Comply with requirements in Section 220523.12 "Ball Valves for Plumbing Piping," Section 220523.13 "Butterfly Valves for Plumbing Piping," Section 220523.14 "Check Valves for Plumbing Piping," and Section 220523.15 "Gate Valves for Plumbing Piping."

B. Install shutoff valves and unions or flanged joints at compressed-air piping to air compressors.

C. Install shutoff valve at inlet to each automatic drain valve, filter, lubricator, and pressure regulator.

D. Install check valves to maintain correct direction of compressed-air flow to and from compressed-air piping specialties and equipment.

3.6 DIELECTRIC FITTING INSTALLATION

A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.

B. NPS 2 and Smaller: Use dielectric unions.

C. NPS 2-1/2 to NPS 4: Use dielectric flanges.

3.7 FLEXIBLE PIPE CONNECTOR INSTALLATION

A. Install flexible pipe connectors in discharge piping of the air compressor.

B. Install bronze-hose flexible pipe connectors in copper compressed-air tubing.

C. Install stainless-steel-hose flexible pipe connectors in steel compressed-air piping.

3.8 SPECIALTY INSTALLATION

A. Install safety valves on receivers in quantity and size to relieve at least the capacity of connected air compressors.

B. Install air-main pressure regulators in compressed-air piping at or near air compressor.

C. Install air-line pressure regulators in branch piping to equipment and tools.

D. Install automatic drain valves on aftercoolers, receivers, and dryers. Discharge condensate onto nearest floor drain.

E. Install coalescing filters in compressed-air piping at or near air compressors and upstream from mechanical filters. Mount on wall at locations indicated.

F. Install mechanical filters in compressed-air piping at or near air the compressor and downstream from coalescing filters. Mount on wall at locations indicated.

G. Install air-line lubricators in branch piping to machine tools. Mount on wall at locations indicated.

H. Install quick couplings at piping terminals for hose connections.

I. Install hose assemblies at hose connections.

3.9 CONNECTIONS

A. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment and machine.

B. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment and machine.

3.10 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment" for seismic-restraint devices.

B. Comply with requirements in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment" for pipe hanger and support devices.

C. Vertical Piping: MSS Type 8 or 42, clamps.

D. Individual, Straight, Horizontal Piping Runs:

1. 100 Feet or Less: MSS Type 1, adjustable, steel clevis hangers.
2. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.

E. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.

F. Base of Vertical Piping: MSS Type 52, spring hangers.

G. Support horizontal piping within 12 inches of each fitting and coupling.

H. Rod diameter may be reduced 1 size for double-rod hangers, with 3/8-inch minimum rods.

I. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1/4: 60 inches with 3/8-inch rod.
2. NPS 3/8 and NPS 1/2: 72 inches with 3/8-inch rod.
3. NPS 3/4: 84 inches with 3/8-inch rod.
4. NPS 1: 96 inches with 3/8-inch rod.
5. NPS 1-1/4: 108 inches with 3/8-inch rod.
6. NPS 1-1/2: 10 feet with 3/8-inch rod.
7. NPS 2: 11 feet with 3/8-inch rod.

J. Install supports for vertical copper tubing every 10 feet.

K. Use manufacturer's recommended hangers and supports for aluminum piping system.

1. Description: Wire rope using adjustable camlock system with standard threaded stud for connection to provided hangers.
2. Hangers: UV-stabilized nylon and galvanized clevis style.

3.11 LABELING AND IDENTIFICATION

A. Install identifying labels and devices for general-service compressed-air piping, valves, and specialties. Comply with requirements in Section 220553 "Identification for Plumbing Piping and Equipment."

3.12 FIELD QUALITY CONTROL

A. Perform field tests and inspections.

B. Tests and Inspections:

1. Piping Leak Tests for Metal Compressed-Air Piping: Test new and modified parts of existing piping. Cap and fill general-service compressed-air piping with oil-free dry air or gaseous nitrogen to pressure of 50 psig above system operating pressure, but not less than 150 psig. Isolate test source and let stand for four hours to equalize temperature. Refill system, if required, to test pressure; hold for two hours with no drop in pressure.
2. Repair leaks and retest until no leaks exist.
3. Inspect filters, lubricators and pressure regulators for proper operation.

C. Prepare test reports.

END OF SECTION 221513

SECTION 221519 - GENERAL-SERVICE PACKAGED AIR COMPRESSORS AND RECEIVERS

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. Lubricated, reciprocating air compressors.
2. Oil-free, reciprocating air compressors.
3. Oilless, reciprocating air compressors.
4. Inlet-air filters.
5. Air-cooled, compressed-air aftercoolers.
6. Desiccant compressed-air dryers.

1.3 DEFINITIONS

A. Actual Air: Air delivered from air compressors. Flow rate is delivered compressed air measured in acfm.

B. Standard Air: Free air at 68 deg F and 1 atmosphere before compression or expansion and measured in scfm.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings:

1. Include diagrams for power, signal, and control wiring.

C. Delegated-Design Submittal: For compressed-air equipment mounting.

1. Detail fabrication and assembly of supports.
2. Include design calculations for selecting vibration isolators and for designing vibration isolation bases.

1.5 INFORMATIONAL SUBMITTALS

A. Seismic Qualification Certificates: For compressed-air equipment, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For compressed-air equipment to include in emergency, operation, and maintenance manuals.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Air-Compressor, Inlet-Air-Filter Elements: Equal to 100 percent of amount installed, but no fewer than 2 units.
2. Belts: Two for each belt-driven compressor.

1.8 FIELD CONDITIONS

A. Interruption of Existing Compressed-Air Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:

1. Notify Owner no fewer than two days in advance of proposed interruption of compressed-air service.
2. Do not proceed with interruption of compressed-air service without Owner's written permission.

1.9 COORDINATION

A. Coordinate sizes and locations of concrete bases with actual equipment provided.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. ASME Compliance: Fabricate and label receivers to comply with ASME Boiler and Pressure Vessel Code.

2.2 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design compressed-air equipment mounting.

2.3 GENERAL REQUIREMENTS FOR PACKAGED AIR COMPRESSORS AND RECEIVERS

A. General Description: Factory-assembled, -wired, -piped, and -tested; electric-motor-driven; air-cooled; continuous-duty air compressors and receivers that deliver air of quality equal to intake air.

B. Control Panels: Automatic control station with load control and protection functions. Comply with NEMA ICS 2 and UL 508.

1. Enclosure: NEMA ICS 6, Type 12 control panel unless otherwise indicated.
2. Motor Controllers: Full-voltage, combination magnetic type with undervoltage release feature and motor-circuit-protector-type disconnecting means and short-circuit protective device.
3. Control Voltage: 120-V ac or less, using integral control power transformer.
4. Motor Overload Protection: Overload relay in each phase.
5. Starting Devices: Hand-off-automatic selector switch in cover of control panel, plus pilot device for automatic control.
6. Instrumentation: Include discharge-air pressure gage, air-filter maintenance indicator, hour meter, compressor discharge-air and coolant temperature gages, and control transformer.

C. Receivers: Steel tank constructed according to ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.

1. Pressure Rating: At least as high as highest discharge pressure of connected compressors, and bearing appropriate code symbols.
2. Interior Finish: Corrosion-resistant coating.
3. Accessories: Include safety valve, pressure gage, drain, and pressure-reducing valve.

D. Mounting Frame: Fabricate mounting and attachment to pressure vessel with reinforcement strong enough to resist packaged equipment movement during a seismic event when base is anchored to building structure.

2.4 LUBRICATED, RECIPROCATING AIR COMPRESSORS

A. Compressor(s): Lubricated, reciprocating-piston type with lubricated compression chamber and crankcase.

1. Submerged gear-type oil pump.
2. Oil filter.
3. Combined high discharge-air temperature and low lubrication-oil pressure switch.
4. Belt guard totally enclosing pulleys and belts.

B. Capacities and Characteristics:

1. Air Compressor(s): One; single stage.
2. Standard-Air Capacity of Each Air Compressor: See schedule.
3. Actual-Air Capacity of Each Air Compressor: See schedule.
4. Discharge-Air Pressure: See schedule.
5. Intake-Air Temperature: See schedule.
6. Discharge-Air Temperature: See schedule.
7. Mounting: See schedule.
8. Motor (Each Air Compressor):

    a. Horsepower: See schedule.
    b. Speed: See schedule.

9. Electrical Characteristics:

    a. Volts: See schedule.
    b. Phase(s): See schedule.
    c. Hertz: See schedule.
    d. Full-Load Amperes: See schedule.

10. Receiver: ASME construction steel tank.

    a. Arrangement: See schedule.
    b. Capacity: See schedule.
    c. Interior Finish: Epoxy or galvanized coating.
    d. Pressure Rating: 150 psig minimum.
    e. Pressure Regulator Setting: See schedule.
    f. Pressure Relief Valve Setting: See schedule.
    g. Drain: Automatic valve.

2.5 OIL-FREE, RECIPROCATING AIR COMPRESSORS

A. Compressor(s): Oil-free, reciprocating-piston type with nonlubricated compression chamber, lubricated crankcase, and of construction that prohibits oil from entering compression chamber.

1. Submerged gear-type oil pump.
2. Oil filter.
3. Combined high discharge-air temperature and low lubrication-oil pressure switch.
4. Belt guard totally enclosing pulleys and belts.

B. Capacities and Characteristics:

1. Air Compressor(s): One; single stage.
2. Standard-Air Capacity of Each Air Compressor: See schedule.
3. Actual-Air Capacity of Each Air Compressor: See schedule.
4. Discharge-Air Pressure: See schedule.
5. Intake-Air Temperature: See schedule.
6. Discharge-Air Temperature: See schedule.
7. Mounting: See schedule.
8. Motor (Each Air Compressor):

    a. Horsepower: See schedule.
    b. Speed: See schedule.

9. Electrical Characteristics:

a. Volts: See schedule.
b. Phase(s): See schedule.
c. Hertz: See schedule.
d. Full-Load Amperes: See schedule.

10. Receiver: ASME construction steel tank.

a. Arrangement: See schedule.
b. Capacity: See schedule.
c. Interior Finish: Epoxy or galvanized coating.
d. Pressure Rating: 150 psig minimum.
e. Pressure Regulator Setting: See schedule.
f. Pressure Relief Valve Setting: See schedule.
g. Drain: Automatic valve.

2.6 OILLESS, RECIPROCATING AIR COMPRESSORS

A. Compressor(s): Oilless (nonlubricated), reciprocating-piston type, with sealed oil-free bearings, that deliver air of quality equal to intake air.

1. High discharge-air temperature switch.
2. Belt guard totally enclosing pulleys and belts.

B. Capacities and Characteristics:

1. Air Compressor(s): One; single stage.
2. Standard-Air Capacity of Each Air Compressor: See schedule.
3. Actual-Air Capacity of Each Air Compressor: See schedule.
4. Discharge-Air Pressure: See schedule.
5. Intake-Air Temperature: See schedule.
6. Discharge-Air Temperature: See schedule.
7. Mounting: See schedule.
8. Motor (Each Air Compressor):

a. Horsepower: See schedule.
b. Speed: See schedule.

9. Electrical Characteristics:

a. Volts: See schedule.
b. Phase(s): See schedule.
c. Hertz: See schedule.
d. Full-Load Amperes: See schedule.

10. Receiver: ASME construction steel tank.

a. Arrangement: See schedule.
b. Capacity: See schedule.
c. Interior Finish: Epoxy or galvanized coating.
d. Pressure Rating: 150 psig minimum.
e. Pressure Regulator Setting: See schedule.
f. Pressure Relief Valve Setting: See schedule.
g. Drain: Automatic valve.

2.7 INLET-AIR FILTERS

A. Description: Combination inlet-air filter-silencer, suitable for remote installation, for each air compressor.

1. Construction: Weatherproof housing for replaceable, dry-type filter element, with silencer tubes or other method of sound reduction.
2. Capacity: Match capacity of air compressor, with filter having collection efficiency of 99 percent retention of particles larger than 10 micrometers.

B. Description: Combination inlet-air filter-silencer, suitable for remote installation, for multiple air compressors.

1. Construction: Weatherproof housing for replaceable, dry-type filter element, with silencer tubes or other method of sound reduction.
2. Capacity: Match total capacity of connected air compressors, with filter having collection efficiency of 99 percent retention of particles larger than 10 micrometers.

2.8 AIR-COOLED, COMPRESSED-AIR AFTERCOOLERS

A. Description: Electric-motor-driven, fan-operation, finned-tube unit; rated at 250 psig and leak tested at 350-psig minimum air pressure; in capacities indicated. Size units to cool compressed air in compressor-rated capacities to 10 deg F above summertime maximum ambient temperature. Include moisture separator and automatic drain.

B. Capacities and Characteristics:

1. Standard-Air Capacity of Each Aftercooler: See schedule.
2. Pressure: See schedule.
3. Entering, Compressed-Air Temperature: See schedule.
4. Leaving, Compressed-Air Temperature: See schedule.
5. Ambient-Air Temperature: See schedule.
6. Maximum Compressed-Air-Pressure Drop: See schedule.
7. Motor Horsepower: See schedule.
8. Electrical Characteristics:

   a. Volts: See schedule.
   b. Phase(s): See schedule.
   c. Hertz: 60
   d. Full-Load Amperes: See schedule.
   e. Minimum Circuit Ampacity: See schedule.
   f. Maximum Overcurrent Protection: See schedule.

2.9 DESICCANT COMPRESSED-AIR DRYERS

A. Description: Twin-tower unit with purge system, mufflers, and capability to deliver plus 10 deg F**,** 100-psig air at dew point. Include dew point controlled purge, step-down transformers, disconnect switches, inlet and outlet pressure gages, thermometers, automatic controls, and filters.

B. Capacities and Characteristics:

1. Standard-Air Capacity of Each Compressed-Air Dryer: See schedule.

2. Pressure: See schedule.
3. Entering-Air Temperature: See schedule.
4. Leaving-Air Temperature: See schedule.
5. Leaving-Air Dew Point Temperature: See schedule.
6. Ambient-Air Temperature: See schedule.
7. Maximum Air-Pressure Drop: See schedule.
8. Inlet Filter: 5 micrometers.
9. Outlet Filter: 1 micrometer(s).
10. Electrical Characteristics:

    a. Volts: See schedule.
    b. Phase(s): See schedule.
    c. Hertz: 60.
    d. Full-Load Amperes: See schedule.

2.10 MOTORS

A. Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Section 220513 "Common Motor Requirements for Plumbing Equipment."

1. Enclosure: See schedule.
2. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load does not require motor to operate in service factor range above 1.0.

PART 3 - EXECUTION

3.1 EQUIPMENT INSTALLATION

A. Equipment Mounting:

1. Install air compressors and aftercoolers and air dryers on cast-in-place concrete equipment base(s). Comply with requirements for equipment bases and foundations specified in Section 033000 "Cast-in-Place Concrete."
2. Comply with requirements for vibration isolation devices specified in Section 220548.13 "Vibration Controls for Plumbing Piping and Equipment."

B. Install compressed-air equipment anchored to substrate.

C. Arrange equipment so controls and devices are accessible for servicing.

D. Maintain manufacturer's recommended clearances for service and maintenance.

E. Install the following devices on compressed-air equipment:

1. Thermometer, Pressure Gage, and Safety Valve: Install on each compressed-air receiver.
2. Pressure Regulators: Install downstream from air compressors and dryers.
3. Automatic Drain Valves: Install on aftercoolers, receivers, and dryers. Discharge condensate over nearest floor drain.

3.2 CONNECTIONS

A. Comply with requirements for piping specified in Section 221513 "General-Service Compressed-Air Piping." Drawings indicate general arrangement of piping, fittings, and specialties.

B. Where installing piping adjacent to machine, allow space for service and maintenance.

3.3 IDENTIFICATION

A. Identify general-service air compressors and components. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.4 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.
2. Check for lubricating oil in lubricated-type equipment.
3. Check belt drives for proper tension.
4. Verify that air-compressor inlet filters and piping are clear.
5. Check for equipment vibration-control supports and flexible pipe connectors, and verify that equipment is properly attached to substrate.
6. Check safety valves for correct settings. Ensure that settings are higher than air-compressor discharge pressure, but not higher than rating of system components.
7. Check for proper seismic restraints.
8. Drain receiver tanks.
9. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
10. Test and adjust controls and safeties.

3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain air compressors, aftercoolers, and air dryers.

END OF SECTION 221519

SECTION 223300 - ELECTRIC, DOMESTIC-WATER HEATERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   1. Commercial, light-duty, storage, electric, domestic-water heaters.
   2. Domestic-water heater accessories.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

   1. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings:

   1. Include diagrams for power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Equipment room drawing or BIM model, drawn to scale, on which the items described in this Section are shown and coordinated with all building trades.

B. Seismic Qualification Data: Certificates, for commercial domestic-water heaters, accessories, and components, from manufacturer.

   1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
   2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
   3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

C. Product Certificates: For each type of commercial, electric, domestic-water heater.

D. Domestic-Water Heater Labeling: Certified and labeled by testing agency acceptable to authorities having jurisdiction.

E. Source quality-control reports.

F. Field quality-control reports.

G. Sample Warranty: For special warranty.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For electric, domestic-water heaters to include emergency, operation, and maintenance manuals.

1.6 COORDINATION

A. Coordinate sizes and locations of concrete bases with actual equipment provided.

1.7 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of electric, domestic-water heaters that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures including storage tank and supports.
b. Faulty operation of controls.
c. Deterioration of metals, metal finishes, and other materials beyond normal use.

2. Warranty Periods: From date of Substantial Completion.

a. Commercial, Light-Duty, Storage, Electric, Domestic-Water Heaters:

1) Storage Tank: Five years.
2) Controls and Other Components: Three years.

b. Expansion Tanks: Five years.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and use.

B. ASHRAE/IES Compliance: Applicable requirements in ASHRAE/IES 90.1.

C. ASME Compliance: Where ASME-code construction is indicated, fabricate and label commercial, domestic-water heater storage tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.

D. NSF Compliance: Fabricate and label equipment components that will be in contact with potable water to comply with NSF 61 and NSF 372.

2.2 COMMERCIAL, ELECTRIC, DOMESTIC-WATER HEATERS

A. Commercial, Light-Duty, Storage, Electric, Domestic-Water Heaters:

1. Source Limitations: Obtain domestic-water heaters from single source from single manufacturer.
2. Standard: UL 174.
3. Storage-Tank Construction: Steel, vertical arrangement.

    a. Tappings: ASME B1.20.1 pipe thread.
    b. Pressure Rating: 150 psig.
    c. Interior Finish: Comply with NSF 61 and NSF 372 barrier materials for potable-water tank linings, including extending lining material into tappings.

4. Factory-Installed, Storage-Tank Appurtenances:

    a. Anode Rod: Replaceable magnesium.
    b. Dip Tube: Required unless cold-water inlet is near bottom of tank.
    c. Drain Valve: Corrosion-resistant metal with hose-end connection.
    d. Insulation: Comply with ASHRAE/IES 90.1.
    e. Jacket: Steel with enameled finish or high-impact composite material.
    f. Heat-Trap Fittings: Inlet type in cold-water inlet and outlet type in hot-water outlet.
    g. Heating Elements: Electric, screw-in immersion type.
    h. Temperature Control: Adjustable thermostat.
    i. Safety Control: High-temperature-limit cutoff device or system.
    j. Relief Valve: ASME rated and stamped for combination temperature-and-pressure relief valves. Include relieving capacity at least as great as heat input, and include pressure setting less than working-pressure rating of domestic-water heater. Select relief valve with sensing element that extends into storage tank.

5. Special Requirements: NSF 5 construction with legs for off-floor installation.

B. Capacity and Characteristics:

1. Capacity: See schedule.
2. Recovery: See schedule.
3. Temperature Setting: See schedule.
4. Power Demand: See schedule.
5. Heating Elements:

    a. Number of Elements: See schedule.
    b. Kilowatts Each Element: See schedule.
    c. Number of Stages: See schedule.

6. Electrical Characteristics:

    a. Volts: See schedule.
    b. Phases: See schedule.
    c. Hertz: 60 Hz.

2.3 DOMESTIC-WATER HEATER ACCESSORIES

A. Domestic-Water Expansion Tanks:

1. Source Limitations: Obtain domestic-water expansion tanks from single source from single manufacturer.
2. Description: Steel pressure-rated tank constructed with welded joints and factory-installed, butyl-rubber diaphragm. Include air precharge to minimum system-operating pressure at tank.

3. Construction:

   a. Tappings: Factory-fabricated steel, welded to tank before testing and labeling. Include ASME B1.20.1 pipe thread.
   b. Interior Finish: Comply with NSF 61 and NSF 372 barrier materials for potable-water tank linings, including extending finish into and through tank fittings and outlets.
   c. Air-Charging Valve: Factory installed.

4. Capacity and Characteristics:

   a. Working-Pressure Rating: 150 psig.
   b. Capacity Acceptable: See schedule.
   c. Air Precharge Pressure: See schedule.

B. Drain Pans: Corrosion-resistant metal with raised edge. Include dimensions not less than base of domestic-water heater, and include drain outlet not less than NPS 3/4 with ASME B1.20.1 pipe threads.

C. Combination Temperature-and-Pressure Relief Valves: ASME rated and stamped. Include relieving capacity at least as great as heat input, and include pressure setting less than working-pressure rating of domestic-water heater. Select relief valves with sensing element that extends into storage tank.

D. Pressure Relief Valves: ASME rated and stamped. Include pressure setting less than working-pressure rating of domestic-water heater.

E. Vacuum Relief Valves: ANSI Z21.22/CSA 4.4.

F. Shock Absorbers: ASSE 1010 or PDI-WH 201, Size A water hammer arrester.

2.4 SOURCE QUALITY CONTROL

A. Factory Tests: Test and inspect domestic-water heaters specified to be ASME-code construction, in accordance with ASME Boiler and Pressure Vessel Code.

B. Hydrostatically test commercial domestic-water heaters to minimum of one and one-half times pressure rating before shipment.

C. Electric, domestic-water heaters will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 DOMESTIC-WATER HEATER INSTALLATION

A. Commercial, Electric, Domestic-Water Heater Mounting: Install commercial, electric, domestic-water heaters on concrete base. Comply with requirements for concrete bases specified in Section 033000 "Cast-in-Place Concrete."

1. Exception: Omit concrete bases for commercial, electric, domestic-water heaters if installation on stand, bracket, suspended platform, or directly on floor is indicated.
2. Maintain manufacturer's recommended clearances.
3. Arrange units so controls and devices that require servicing are accessible.
4. 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 concrete base.
5. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
6. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
7. Install anchor bolts to elevations required for proper attachment to supported equipment.
8. Anchor domestic-water heaters to substrate.

B. Install electric, domestic-water heaters level and plumb, in accordance with layout drawings, original design, and referenced standards. Maintain manufacturer's recommended clearances. Arrange units so controls and devices needing service are accessible.

1. Install shutoff valves on domestic-water-supply piping to domestic-water heaters and on domestic-hot-water outlet piping. Comply with requirements for shutoff valves specified in Section 220523.12 "Ball Valves for Plumbing Piping," Section 220523.13 "Butterfly Valves for Plumbing Piping," and Section 220523.15 "Gate Valves for Plumbing Piping."

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 domestic-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 combination temperature-and-pressure relief valves in water piping for electric, domestic-water heaters without storage. Extend domestic-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.

E. 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 electric, domestic-water heaters that do not have tank drains. Comply with requirements for hose-end drain valves specified in Section 221119 "Domestic Water Piping Specialties."

F. Install thermometers on outlet piping of electric, domestic-water heaters. Comply with requirements for thermometers specified in Section 220519 "Meters and Gages for Plumbing Piping."

G. Fill electric, domestic-water heaters with water.

H. Charge domestic-water expansion tanks with air to required system pressure.

I. Install dielectric fittings in all locations where piping of dissimilar metals is to be joined. The wetted surface of the dielectric fitting contacted by potable water shall contain less than 0.25 percent of lead by weight.

3.2 PIPING CONNECTIONS

A. Comply with requirements for piping specified in Section 221116 "Domestic Water Piping." Drawings indicate general arrangement of piping, fittings, and specialties.

B. Where installing piping adjacent to electric, domestic-water heaters, allow space for service and maintenance of water heaters. Arrange piping for easy removal of domestic-water heaters.

3.3 IDENTIFICATION

A. Identify system components. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.4 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

C. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

D. Perform tests and inspections with the assistance of a factory-authorized service representative.

E. Tests and Inspections:

1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
2. Operational Test: After electrical circuitry has been energized, start units to confirm proper operation.
3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

F. Electric, domestic-water heaters will be considered defective if they do not pass tests and inspections.

G. Prepare test and inspection reports.

3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain commercial, electric, domestic-water heaters. Training shall be a minimum of two hour(s).

END OF SECTION 223300

SECTION 224213.13 - COMMERCIAL WATER CLOSETS

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. Wall-mounted water closets.
2. Flushometer valves.
3. Toilet seats.
4. Supports.

1.3 DEFINITIONS

A. Effective Flush Volume: Average of two reduced flushes and one full flush per fixture.

B. Remote Water Closet: Located more than 30 feet from other drain line connections or fixture and where less than 1.5 drainage fixture units are upstream of the drain line connection.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for water closets.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings: Include diagrams for power, signal, and control wiring.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For flushometer valves and electronic sensors to include in operation and maintenance manuals.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that are packaged with protective covering for storage and identified with labels describing contents.

1. Flushometer-Valve Repair Kits: Equal to 10 percent of amount of each type installed, but no fewer than six of each type.

PART 2 - PRODUCTS

2.1 WALL-MOUNTED WATER CLOSETS

A. Water Closets, Wall Mounted, Top Spud, Accessible:

1. Bowl:

   a. Standards: ASME A112.19.2/CSA B45.1 and ASME A112.19.5.
   b. Material: Vitreous china.
   c. Type: Siphon jet.
   d. Style: Flushometer valve.
   e. Height: Standard.
   f. Rim Contour: Elongated.
   g. Water Consumption: 1.28 gal. per flush.
   h. Spud Size and Location: NPS 1-1/2; top.

2. Support: Water closet carrier.
3. Water-Closet Mounting Height: Standard or Handicapped/elderly according to ICC/ANSI A117.1.

2.2 FLUSHOMETER VALVES

A. Solenoid-Actuator, Diaphragm Flushometer Valves:

1. Standard: ASSE 1037.
2. Minimum Pressure Rating: 125 psig.
3. Features: Include integral check stop and backflow-prevention device.
4. Material: Brass body with corrosion-resistant components.
5. Exposed Flushometer-Valve Finish: Chrome plated.
6. Panel Finish: Chrome plated or stainless steel.
7. Style: Exposed.
8. Actuator: Solenoid complying with UL 1951, and listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
9. Trip Mechanism: Battery-powered electronic sensor complying with UL 1951, and listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
10. Consumption: 1.28 gal. per flush.
11. Minimum Inlet: NPS 1.

2.3 TOILET SEATS

A. Toilet Seats;

1. Standard: IAPMO/ANSI Z124.5.
2. Material: Plastic.
3. Type: Commercial (Standard).
4. Shape: Elongated rim, open front.
5. Hinge: Self-sustaining, check.

6. Hinge Material: Noncorroding metal.
7. Seat Cover: Not required.
8. Color: White.

2.4 SUPPORTS

A. Water Closet Carrier:

1. Standard: ASME A112.6.1M.
2. Description: Waste-fitting assembly, as required to match drainage piping material and arrangement with faceplates, couplings gaskets, and feet; bolts and hardware matching fixture. Include additional extension coupling, faceplate, and feet for installation in wide pipe space.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before water-closet installation.

B. Examine walls and floors for suitable conditions where water closets will be installed.

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

3.2 INSTALLATION, GENERAL

A. Water-Closet Installation:

1. Install level and plumb according to roughing-in drawings.
2. Install accessible, wall-mounted water closets at mounting height for handicapped/elderly, according to ICC/ANSI A117.1.

B. Support Installation:

1. Install supports, affixed to building substrate, for floor-mounted, back-outlet water closets.
2. Use carrier supports with waste-fitting assembly and seal.
3. Install wall-mounted, back-outlet water-closet supports with waste-fitting assembly and waste-fitting seals; and affix to building substrate.

C. Flushometer-Valve Installation:

1. Install flushometer-valve, water-supply fitting on each supply to each water closet.
2. Attach supply piping to supports or substrate within pipe spaces behind fixtures.
3. Install actuators in locations that are easy for people with disabilities to reach.
4. Install fresh batteries in battery-powered, electronic-sensor mechanisms.

D. Install toilet seats on water closets.

E. Wall Flange and Escutcheon Installation:

1. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations and within cabinets and millwork.
2. Install deep-pattern escutcheons if required to conceal protruding fittings.
3. Comply with escutcheon requirements specified in Section 220518 "Escutcheons for Plumbing Piping."

F. Joint Sealing:

1. Seal joints between water closets and walls and floors using sanitary-type, one-part, mildew-resistant silicone sealant.
2. Match sealant color to water-closet color.
3. Comply with sealant requirements specified in Section 079200 "Joint Sealants."

3.3 CONNECTIONS

A. Connect water closets with water supplies and soil, waste, and vent piping. Use size fittings required to match water closets.

B. Comply with water piping requirements specified in Section 221116 "Domestic Water Piping."

C. Comply with soil and waste piping requirements specified in Section 221316 "Sanitary Waste and Vent Piping."

D. Where installing piping adjacent to water closets, allow space for service and maintenance.

3.4 ADJUSTING

A. Operate and adjust water closets and controls. Replace damaged and malfunctioning water closets, fittings, and controls.

B. Adjust water pressure at flushometer valves to produce proper flow.

C. Install fresh batteries in battery-powered, electronic-sensor mechanisms.

3.5 CLEANING AND PROTECTION

A. Clean water closets and fittings with manufacturers' recommended cleaning methods and materials.

B. Install protective covering for installed water closets and fittings.

C. Do not allow use of water closets for temporary facilities unless approved in writing by Owner.

END OF SECTION 224213.13

SECTION 224213.16 - COMMERCIAL URINALS

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. Wall-hung urinals.
   2. Urinal flushometer valves.
   3. Supports.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

   1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for urinals.
   2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings: Include diagrams for power, signal, and control wiring.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For flushometer valves and electronic sensors to include in operation and maintenance manuals.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that are packaged with protective covering for storage and identified with labels describing contents.

   1. Flushometer-Valve Repair Kits: Equal to 10 percent of amount of each type installed, but no fewer than six of each type.

PART 2 - PRODUCTS

2.1 WALL-HUNG URINALS

A. Urinals, Wall Hung, Back Outlet, Siphon Jet, Accessible:

1. Fixture:

    a. Standards: ASME A112.19.2/CSA B45.1 and ASME A112.19.5.
    b. Material: Vitreous china.
    c. Type: Siphon jet.
    d. Strainer or Trapway: Manufacturer's standard strainer with integral trap.
    e. Water Consumption: Water saving.
    f. Spud Size and Location: NPS 3/4; top.
    g. Outlet Size and Location: NPS 2; back.
    h. Color: White.

2. Waste Fitting:

    a. Standard: ASME A112.18.2/CSA B125.2 for coupling.
    b. Size: NPS 2.

3. Support: Type I Urinal Carrier with fixture support plates and coupling with seal and fixture bolts and hardware matching fixture. Include rectangular, steel uprights.
4. Urinal Mounting Height: Standard or Handicapped/elderly according to ICC A117.1.

2.2 URINAL FLUSHOMETER VALVES

A. Solenoid-Actuator, Diaphragm Flushometer Valves:

1. Standard: ASSE 1037.
2. Minimum Pressure Rating: 125 psig.
3. Features: Include integral check stop and backflow-prevention device.
4. Material: Brass body with corrosion-resistant components.
5. Exposed Flushometer-Valve Finish: Chrome plated.
6. Panel Finish: Chrome plated or stainless steel.
7. Style: Exposed.
8. Actuator: Solenoid complying with UL 1951; listed and labeled as defined in NFPA 70, by a qualified testing agency; and marked for intended location and application.
9. Trip Mechanism: Battery-powered electronic sensor complying with UL 1951; listed and labeled as defined in NFPA 70, by a qualified testing agency; and marked for intended location and application.
10. Consumption: 0.5 gal. per flush.
11. Minimum Inlet: NPS 3/4.

2.3 SUPPORTS

A. Type I Urinal Carrier:

1. Standard: ASME A112.6.1M.

B. Type II Urinal Carrier:

1. Standard: ASME A112.6.1M.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before urinal installation.

B. Examine walls and floors for suitable conditions where urinals will be installed.

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

3.2 INSTALLATION

A. Urinal Installation:

1. Install urinals level and plumb according to roughing-in drawings.
2. Install wall-hung, back-outlet urinals onto waste fitting seals and attached to supports.
3. Install wall-hung, bottom-outlet urinals with tubular waste piping attached to supports.
4. Install accessible, wall-mounted urinals at mounting height for the handicapped/elderly, according to ICC/ANSI A117.1.

B. Support Installation:

1. Install supports, affixed to building substrate, for wall-hung urinals.
2. Use off-floor carriers with waste fitting and seal for back-outlet urinals.
3. Use carriers without waste fitting for urinals with tubular waste piping.
4. Use chair-type carrier supports with rectangular steel uprights for accessible urinals.

C. Flushometer-Valve Installation:

1. Install flushometer-valve water-supply fitting on each supply to each urinal.
2. Attach supply piping to supports or substrate within pipe spaces behind fixtures.
3. Install lever-handle flushometer valves for accessible urinals with handle mounted on open side of compartment.
4. Install fresh batteries in battery-powered, electronic-sensor mechanisms.

D. Wall Flange and Escutcheon Installation:

1. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations.
2. Install deep-pattern escutcheons if required to conceal protruding fittings.
3. Comply with escutcheon requirements specified in Section 220518 "Escutcheons for Plumbing Piping."

E. Joint Sealing:

1. Seal joints between urinals and walls and floors using sanitary-type, one-part, mildew-resistant silicone sealant.
2. Match sealant color to urinal color.
3. Comply with sealant requirements specified in Section 079200 "Joint Sealants."

3.3 CONNECTIONS

A. Connect urinals with water supplies and soil, waste, and vent piping. Use size fittings required to match urinals.

B. Comply with water piping requirements specified in Section 221116 "Domestic Water Piping."

C. Comply with soil and waste piping requirements specified in Section 221316 "Sanitary Waste and Vent Piping."

D. Where installing piping adjacent to urinals, allow space for service and maintenance.

3.4 ADJUSTING

A. Operate and adjust urinals and controls. Replace damaged and malfunctioning urinals, fittings, and controls.

B. Adjust water pressure at flushometer valves to produce proper flow.

C. Install fresh batteries in battery-powered, electronic-sensor mechanisms.

3.5 CLEANING AND PROTECTION

A. Clean urinals and fittings with manufacturers' recommended cleaning methods and materials.

B. Install protective covering for installed urinals and fittings.

C. Do not allow use of urinals for temporary facilities unless approved in writing by Owner.

END OF SECTION 224213.16

SECTION 224216.13 - COMMERCIAL LAVATORIES

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. Vitreous-china, wall-mounted lavatories.
2. Automatically operated lavatory faucets.
3. Supply fittings.
4. Waste fittings.
5. Lavatory supports.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for lavatories.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings: Include diagrams for power, signal, and control wiring of automatic faucets.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Counter cutout templates for mounting of counter-mounted lavatories.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For lavatories and faucets to include in operation and maintenance manuals.

1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:

a. Servicing and adjustments of automatic faucets.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Faucet Washers and O-Rings: Equal to 10 percent of amount of each type and size installed.
2. Faucet Cartridges and O-Rings: Equal to 5 percent of amount of each type and size installed.

PART 2 - PRODUCTS

2.1 VITREOUS-CHINA, WALL-MOUNTED LAVATORIES

A. Lavatory - Vitreous China, Wall Mounted, with Back:

1. Fixture:

a. Standard: ASME A112.19.2/CSA B45.1.
b. Type: For wall hanging.
c. Nominal Size: Rectangular, See schedule.
d. Faucet-Hole Punching: See schedule.
e. Faucet-Hole Location: Top.
f. Color: White.
g. Mounting Material: Chair carrier.

2. Faucet: See schedule.
3. Support: Type I, exposed-arm lavatory carrier, Type II, concealed-arm lavatory carrier or Type II, concealed-arm lavatory carrier with escutcheons. Include rectangular, steel uprights.
4. Lavatory Mounting Height: Standard or Handicapped/elderly in accordance with ICC A117.1.

2.2 AUTOMATICALLY OPERATED LAVATORY FAUCETS

A. NSF Standard: Comply with NSF 61 and NSF 372 for faucet materials that will be in contact with potable water.

B. Lavatory Faucets - Automatic Type: Battery Powered Electronic Sensor Operated, Mixing:

1. Standards: ASME A112.18.1/CSA B125.1 and UL 1951.
2. 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.
3. General: Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture hole punchings; coordinate outlet with spout and fixture receptor.
4. Body Type: Single hole.
5. Body Material: Commercial, solid-brass, or die-cast housing with brazed copper and brass waterway.
6. Finish: See schedule.
7. Maximum Flow Rate: 0.5 gpm.
8. Mounting Type: Deck, concealed.
9. Spout: Rigid type.

10. Spout Outlet: Aerator.
11. Drain: Not part of faucet.

2.3 SUPPLY FITTINGS

A. NSF Standard: Comply with NSF 61 and NSF 372 for supply-fitting materials that will be in contact with potable water.

B. Standard: ASME A112.18.1/CSA B125.1.

C. Supply Piping: Chrome-plated-brass pipe or chrome-plated copper tube matching water-supply piping size. Include chrome-plated-brass or stainless steel wall flange.

D. Supply Stops: Chrome-plated-brass, one-quarter-turn, ball-type or compression valve with inlet connection matching supply piping.

E. Operation: Wheel handle.

F. Risers:

1. NPS 3/8.
2. Chrome-plated, rigid-copper-pipe and brass straight or offset tailpieces, Chrome-plated, soft-copper flexible tube or ASME A112.18.6/CSA B125.6, braided- or corrugated-stainless steel, flexible hose riser.

2.4 WASTE FITTINGS

A. Standard: ASME A112.18.2/CSA B125.2.

B. Drain: Grid type with NPS 1-1/4 offset and straight tailpiece.

C. Trap:

1. Size: NPS 1-1/2 by NPS 1-1/4.
2. Material:

a. Chrome-plated, two-piece, cast-brass trap and swivel elbow with 0.032-inch- thick brass tube to wall, two-piece, cast-brass trap and ground-joint swivel elbow with 0.032-inch- thick brass tube to wall or one-piece, cast-brass trap with swivel 0.029-inch- thick tubular brass wall bend; and chrome-plated, brass or steel wall flange.

2.5 LAVATORY SUPPORTS

A. Lavatory Carrier:

1. Standard: ASME A112.6.1M.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before lavatory installation.

B. Examine counters and walls for suitable conditions where lavatories will be installed.

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

3.2 INSTALLATION

A. Install lavatories level and plumb in accordance with roughing-in drawings.

B. Install supports, affixed to building substrate, for wall-mounted lavatories.

C. Install accessible wall-mounted lavatories at handicapped/elderly mounting height for people with disabilities or the elderly, in accordance with ICC A117.1.

D. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons if required to conceal protruding fittings. Comply with escutcheon requirements specified in Section 220518 "Escutcheons for Plumbing Piping."

E. Seal joints between lavatories and walls using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified in Section 079200 "Joint Sealants."

F. Install protective shielding pipe covers and enclosures on exposed supplies and waste piping of accessible lavatories. Comply with requirements in Section 220719 "Plumbing Piping Insulation."

3.3 PIPING CONNECTIONS

A. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.

B. Comply with water piping requirements specified in Section 221116 "Domestic Water Piping."

C. Comply with soil and waste piping requirements specified in Section 221316 "Sanitary Waste and Vent Piping."

3.4 ADJUSTING

A. Operate and adjust lavatories and controls. Replace damaged and malfunctioning lavatories, fittings, and controls.

B. Install new batteries in battery-powered, electronic-sensor mechanisms.

3.5 CLEANING AND PROTECTION

A. After completing installation of lavatories, inspect and repair damaged finishes.

B. Clean lavatories, faucets, and other fittings with manufacturers' recommended cleaning methods and materials.

C. Provide protective covering for installed lavatories and fittings.

D. Do not allow use of lavatories for temporary facilities unless approved in writing by Owner.

END OF SECTION 224216.13

SECTION 224216.16 - COMMERCIAL SINKS

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. Service basins.
2. Sink faucets.
3. Laminar-flow, faucet-spout outlets.
4. Supply fittings.
5. Waste fittings.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for sinks.
2. Include rated capacities, operating characteristics and furnished specialties and accessories.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Counter cutout templates for mounting of counter-mounted lavatories.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For sinks to include in maintenance manuals.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Faucet Washers and O-Rings: Equal to 10 percent of amount of each type and size installed.
2. Faucet Cartridges and O-Rings: Equal to 5 percent of amount of each type and size installed.

PART 2 - PRODUCTS

2.1 SERVICE BASINS

A. Service Basins: Terrazzo, floor mounted.

1. Fixture:

a. Standard: IAPMO PS 99.
b. Shape: Square.
c. Nominal Size: 24 by 24 inches.
d. Height: See schedule.
e. Rim Guard: On all top surfaces.
f. Color: Not applicable.
g. Drain: Grid with NPS 3 outlet.

2. Mounting: On floor and flush to wall.
3. Faucet: See schedule.

2.2 SINK FAUCETS

A. NSF Standard: Comply with NSF 372 for faucet-spout materials that will be in contact with potable water.

B. Sink Faucets: Manual type, single control mixing valve.

1. Commercial, Solid-Brass Faucets
2. Standard: ASME A112.18.1/CSA B125.1.
3. General: Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture hole punchings; coordinate outlet with spout and sink receptor.
4. Body Type: Centerset.
5. Body Material: Commercial, solid brass.
6. Finish: See schedule.
7. Maximum Flow Rate: See schedule.
8. Handle(s): Lever.
9. Mounting Type: Deck, exposed.
10. Spout Type: Swivel gooseneck.
11. Vacuum Breaker: Not required for hose outlet.
12. Spout Outlet: Aerator.

2.3 LAMINAR-FLOW, FAUCET-SPOUT OUTLETS

A. NSF Standard: Comply with NSF 372 for faucet-spout-outlet materials that will be in contact with potable water.

B. Description: Chrome-plated brass, faucet-spout outlet that produces non-aerating, laminar stream. Include external or internal thread that mates with faucet outlet for attachment to faucets where indicated and flow-rate range that includes flow of faucet.

2.4 SUPPLY FITTINGS

A. NSF Standard: Comply with NSF 372 for supply-fitting materials that will be in contact with potable water.

B. Standard: ASME A112.18.1/CSA B125.1.

C. Supply Piping: Chrome-plated brass pipe or chrome-plated copper tube matching water-supply piping size. Include chrome-plated brass or stainless-steel wall flange.

D. Supply Stops: Chrome-plated brass, one-quarter-turn, ball-type or compression valve with inlet connection matching supply piping.

E. Operation: Wheel handle.

F. Risers:

1. NPS 1/2.
2. Chrome-plated, rigid-copper pipe, Chrome-plated, soft-copper flexible tube or ASME A112.18.6, braided or corrugated stainless-steel flexible hose.

2.5 WASTE FITTINGS

A. Standard: ASME A112.18.2/CSA B125.2.

B. Drain: Grid type with NPS 1-1/2 offset and straight tailpiece.

C. Trap:

1. Size: NPS 1-1/2.
2. Material: Chrome-plated, two-piece, cast-brass trap and swivel elbow with 0.032-inch-thick brass tube to wall, two-piece, cast-brass trap and ground-joint swivel elbow with 0.032-inch- thick brass tube to wall or[one-piece, cast-brass trap with swivel 0.029-inch-thick tubular brass wall bend; and chrome-plated brass or steel wall flange.

2.6 GROUT

A. Standard: ASTM C1107/C1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.

B. Characteristics: Nonshrink; recommended for interior and exterior applications.

C. Design Mix: 5000-psi, 28-day compressive strength.

D. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before sink installation.

B. Examine walls, floors, and counters for suitable conditions where sinks will be installed.

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

3.2 INSTALLATION

A. Install sinks level and plumb according to roughing-in drawings.

B. Install accessible wall-mounted sinks at handicapped/elderly mounting height according to ICC/ANSI A117.1.

C. Install water-supply piping with stop on each supply to each sink faucet.

1. Exception: Use ball or gate valves if supply stops are not specified with sink. Comply with valve requirements specified in Section 220523.12 "Ball Valves for Plumbing Piping" and Section 220523.15 "Gate Valves for Plumbing Piping."
2. Install stops in locations where they can be easily reached for operation.

D. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons if required to conceal protruding fittings. Comply with escutcheon requirements specified in Section 220518 "Escutcheons for Plumbing Piping."

E. Seal joints between sinks, counters and walls using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified in Section 079200 "Joint Sealants."

F. Install protective shielding pipe covers and enclosures on exposed supplies and waste piping of accessible sinks. Comply with requirements in Section 220719 "Plumbing Piping Insulation."

3.3 CONNECTIONS

A. Connect sinks with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.

B. Comply with water piping requirements specified in Section 221116 "Domestic Water Piping."

C. Comply with soil and waste piping requirements specified in Section 221316 "Sanitary Waste and Vent Piping."

3.4 ADJUSTING

A. Operate and adjust sinks and controls. Replace damaged and malfunctioning sinks, fittings, and controls.

B. Adjust water pressure at faucets to produce proper flow.

3.5 CLEANING AND PROTECTION

A. After completing installation of sinks, inspect and repair damaged finishes.

B. Clean sinks, faucets, and other fittings with manufacturers' recommended cleaning methods and materials.

C. Provide protective covering for installed sinks and fittings.

D. Do not allow use of sinks for temporary facilities unless approved in writing by Owner.

END OF SECTION 224216.16

SECTION 224233 - WASH FOUNTAINS

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. Semicircular wash fountains.

B. Related Requirements:

1. Section 224216.13 "Commercial Lavatories."
2. Section 224216.16 "Commercial Sinks."

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for wash fountains.
2. Include rated capacities, operating characteristics and furnished specialties and accessories.

B. Shop Drawings: For each type of wash fountain.

1. Include plans, elevations, sections, and mounting details.
2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include diagrams for power, signal, and control wiring.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For wash fountains and components to include in operation and maintenance manuals.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Faucet Washers and O-Rings: Equal to 10 percent of quantity of each type and size installed.

2. Faucet Cartridges and O-Rings: Equal to 5 percent of quantity of each type and size installed.

PART 2 - PRODUCTS

2.1 STAINLESS-STEEL, SEMICIRCULAR WASH FOUNTAINS

A. Wash Fountains: On-floor, stainless-steel, semicircular receptor.

1. Standard: IAPMO IGC 156.
2. 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.
3. Receptor:

    a. Standard: ASME A112.19.3/CSA B45.4 for stainless-steel receptor.
    b. Nominal Diameter: 54 inches.
    c. Height to Rim: 28 inches above floor.
    d. Color or Finish: Not applicable.
    e. Drain: Grid with NPS 2 tailpiece.

4. Spray Head:

    a. Material: Stainless steel or integral part of receptor back.
    b. Number of User Stations: Four.
    c. Spray Nozzles: Chrome-plated brass or stainless steel complying with NSF 61 Annex G and ASME A112.18.1/CSA B125.1.
    d. Control: Collective, foot-rail actuation with thermostatic mixing valve complying with ASSE 1016 and having check stops; comply with NSF 61 Annex G.
    e. Sensor: ASME A112.18.1/CSA B125.1 and UL 1951.

5. Liquid-Soap Dispensers: Manual, for each user station.

    a. Sensor: ASME A112.18.1/CSA B125.1 and UL 1951.

6. Supply Fittings:

    a. Piping: NPS 3/4 copper tubing.
    b. Valves: Shutoff valve on each supply.
    c. Supply Piping: From wall.

7. Waste Fittings:

    a. Standard: ASME A112.18.2/CSA B125.2.
    b. Trap and Drain Piping: NPS 2.
    c. Vent Piping: NPS 2 to ceiling.

8. Shroud: Stainless steel of size to cover supply and vent piping.
9. On-Floor Mounting: Floor bracket and wall bracket attached to concrete or block wall.

    a. Supplies: NPS 3/4 copper tubing with ball, gate, or globe valves.
    b. Drain: Grid with NPS 2 tailpiece.
    c. Drain Piping: NPS 2 P-trap, waste to wall, and wall flange.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in of water-supply, sanitary drainage, and vent piping systems to verify actual locations of piping connections before wash-fountain installation.

B. Examine walls and floors for suitable conditions where wash fountains will be installed.

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

3.2 INSTALLATION

A. Install wash fountains level and plumb according to roughing-in drawings.

B. Install water-supply piping with shutoff valve on each supply to each wash fountain to be connected to domestic-water distribution piping. Use ball or gate valve. Install valves in locations where they can be easily reached for operation. Valves are specified in Section 220523.12 "Ball Valves for Plumbing Piping" and Section 220523.15 "Gate Valves for Plumbing Piping."

C. Install trap and waste piping on each drain outlet of each wash fountain to be connected to sanitary drainage system.

D. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons if required to conceal protruding fittings. Comply with escutcheon requirements specified in Section 220518 "Escutcheons for Plumbing Piping."

E. Seal joints between fixtures and walls using sanitary-type, one-part, mildew-resistant, silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified in Section 079200 "Joint Sealants."

3.3 CONNECTIONS

A. Connect wash fountains with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.

B. Comply with requirements for water piping specified in Section 221116 "Domestic Water Piping."

C. Comply with requirements for soil and waste drainage piping and vent piping specified in Section 221316 "Sanitary Waste and Vent Piping."

D. Install protective-shielding pipe covers and enclosures on exposed supplies and waste piping of accessible wash fountains. Comply with requirements in Section 220719 "Plumbing Piping Insulation."

3.4 ADJUSTING

A. Operate and adjust wash fountains and controls. Replace damaged and malfunctioning wash fountains, fittings, and controls.

B. Adjust water pressure at faucets to produce proper flow.

C. Install fresh batteries in battery-powered, electronic-sensor mechanisms.

3.5 CLEANING AND PROTECTION

A. After installing wash fountains, inspect and repair damaged finishes.

B. Clean wash fountains, faucets, and other fittings with manufacturers' recommended cleaning methods and materials.

C. Provide protective covering for installed wash fountains and fittings.

D. Do not allow use of wash fountains for temporary facilities unless approved in writing by Owner.

END OF SECTION 224233

SECTION 224500 - EMERGENCY PLUMBING FIXTURES

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. Combination units.
2. Supplemental equipment.
3. Water-tempering equipment.

1.3 DEFINITIONS

A. Accessible Fixture: Emergency plumbing fixture that can be approached, entered, and used by people with disabilities.

B. Plumbed Emergency Plumbing Fixture: Fixture with fixed, potable-water supply.

C. Self-Contained Emergency Plumbing Fixture: Fixture with flushing-fluid-solution supply.

D. Tepid: Moderately warm.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include flow rates and capacities, furnished specialties, and accessories.

B. Shop Drawings:

1. Include plans, elevations, sections, and mounting details.
2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.
4. Include diagrams for power, signal, and control wiring.

1.5 INFORMATIONAL SUBMITTALS

A. Product Certificates: Submit certificates of performance testing specified in "Source Quality Control" Article.

B. Field quality-control test reports.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For emergency plumbing fixtures to include in operation and maintenance manuals.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Flushing-Fluid Solution: Separate lot and equal to at least 200 percent of amount of solution installed for each self-contained unit.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. ISEA Standard: Comply with ISEA Z358.1.

C. NSF Standard: Comply with NSF 61 and NSF 372, for fixture materials that will be in contact with potable water.

D. Regulatory Requirements: Comply with requirements in ICC A117.1, ; Public Law 90-480, "Architectural Barriers Act"; and Public Law 101-336, "Americans with Disabilities Act"; for plumbing fixtures for people with disabilities.

2.2 COMBINATION UNITS

A. Standard, Plumbed Emergency Shower with Eyewash Combination Units:

1. Piping:

a. Material: See schedule.
b. Unit Supply: NPS 1-1/4.
c. Unit Drain: Outlet at back or side near bottom.

2. Shower:

a. Capacity: Not less than 20 gpm for at least 15 minutes.
b. Supply Piping: NPS 1 with flow regulator and stay-open control valve.
c. Control-Valve Actuator: Pull rod.
d. Shower Head: 8-inch- minimum diameter, chrome-plated brass or stainless steel.
e. Mounting: Pedestal.

3. Eyewash Unit:

a. Capacity: Not less than 0.4 gpm for at least 15 minutes.
b. Supply Piping: NPS 1/2 with flow regulator and stay-open control valve.
c. Control-Valve Actuator: Paddle.
d. Spray-Head Assembly: Two receptor-mounted spray heads.
e. Receptor: Chrome-plated brass or stainless-steel bowl.
f. Mounting: Attached shower pedestal.
g. Drench-Hose Option: May be provided instead of eyewash unit.

1) Capacity: Not less than 0.4 gpm for at least 15 minutes.
2) Drench Hose: Hand-held spray head with squeeze-handle actuator and hose.
3) Mounting: Bracket on shower pedestal.

2.3 WATER-TEMPERING EQUIPMENT

A. Hot- and Cold-Water, Water-Tempering Equipment:

1. Description: Factory-fabricated equipment with thermostatic mixing valve.

a. Thermostatic Mixing Valve: Designed to provide 8 deg F tepid, potable water at emergency plumbing fixtures, to maintain temperature at plus or minus 5 deg F throughout required 15-minute test period, and in case of unit failure to continue cold-water flow, with union connections, controls, metal piping, and corrosion-resistant enclosure.
b. Supply Connections: For hot and cold water.

2.4 SOURCE QUALITY CONTROL

A. Certify performance of emergency plumbing fixtures by independent testing organization acceptable to authorities having jurisdiction.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in for water piping systems to verify actual locations of piping connections before plumbed emergency plumbing fixture installation.

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

3.2 INSTALLATION OF EMERGENCY PLUMBING FIXTURE INSTALLATION

A. Assemble emergency plumbing fixture piping, fittings, control valves, and other components.

B. Install fixtures level and plumb.

C. Fasten fixtures to substrate.

D. Install shutoff valves in water-supply piping to fixtures, to facilitate maintenance of the equipment. Use ball or gate valve if specific type valve is not indicated. Install valves chained or

locked in open position if permitted. Install valves in locations where they can easily be reached for operation. Comply with requirements for valves specified in Section 220523.12 "Ball Valves for Plumbing Piping" and Section 220523.15 "Gate Valves for Plumbing Piping."

1. Exception: Omit shutoff valve on supply to group of plumbing fixtures that includes emergency equipment.
2. Exception: Omit shutoff valve on supply to emergency equipment if prohibited by authorities having jurisdiction.

E. Install shutoff valve and strainer in steam piping and shutoff valve in condensate return piping. Comply with requirements for steam and condensate piping specified in Section 232213 "Steam and Condensate Heating Piping" and Section 232216 "Steam and Condensate Heating Piping Specialties."

F. Install dielectric fitting in supply piping to emergency equipment if piping and equipment connections are made of different metals. Comply with requirements for dielectric fittings specified in Section 221116 "Domestic Water Piping."

G. Install thermometers in supply and outlet piping connections to water-tempering equipment. Comply with requirements for thermometers specified in Section 220519 "Meters and Gages for Plumbing Piping."

H. Install escutcheons on piping wall and ceiling penetrations in exposed, finished locations. Comply with requirements for escutcheons specified in Section 220518 "Escutcheons for Plumbing Piping."

3.3 CONNECTIONS

A. Connect cold-water-supply piping to plumbed emergency plumbing fixtures not having water-tempering equipment. Comply with requirements for cold-water piping specified in Section 221116 "Domestic Water Piping."

B. Connect hot- and cold-water-supply piping to hot- and cold-water, water-tempering equipment. Connect output from water-tempering equipment to emergency plumbing fixtures. Comply with requirements for hot- and cold-water piping specified in Section 221116 "Domestic Water Piping."

C. Where installing piping adjacent to emergency plumbing fixtures, allow space for service and maintenance of fixtures.

3.4 IDENTIFICATION

A. Install equipment nameplates or equipment markers on emergency plumbing fixtures and equipment and equipment signs on water-tempering equipment. Comply with requirements for identification materials specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.5 FIELD QUALITY CONTROL

A. Mechanical-Component Testing: After plumbing connections have been made, test for compliance with requirements. Verify ability to achieve indicated capacities.

B. Tests and Inspections:

1. Perform each visual and mechanical inspection.
2. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
3. Operational Test: After electrical circuitry has been energized, start units to confirm proper unit operation.
4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

C. Emergency plumbing fixtures and water-tempering equipment will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports.

3.6 ADJUSTING

A. Adjust or replace fixture flow regulators for proper flow.

B. Adjust equipment temperature settings.

END OF SECTION 224500

SECTION 224716 - PRESSURE WATER COOLERS

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 pressure water coolers and related components.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of pressure water cooler.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings: Include diagrams for power, signal, and control wiring.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For pressure water coolers to include in maintenance manuals.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Filter Cartridges: Equal to 100 percent of quantity installed for each type and size indicated, but no fewer than two of each.

PART 2 - PRODUCTS

2.1 PRESSURE WATER COOLERS

A. Pressure Water Coolers: Wall mounted, standard , wheelchair accessible and, bottle filler.

1. Standards:

a. Comply with NSF 61 and NSF 372.

b. Comply with ASHRAE 34, "Designation and Safety Classification of Refrigerants," for water coolers. Provide HFC 134a (tetrafluoroethane) refrigerant unless otherwise indicated.
c. Comply with ICC A117.1.

2. Cabinet: Bi-level with two attached cabinets, all stainless steel.
3. Bubbler: One, with adjustable stream regulator, located on each cabinet deck.
4. Control: Push button.
5. Drain: Grid with NPS 1-1/4 tailpiece.
6. Supply: NPS 3/8 with shutoff valve.
7. Waste Fitting: ASME A112.18.2/CSA B125.2, NPS 1-1/4 brass P-trap.
8. Filter: One or more water filters complying with NSF 42 and NSF 53 for cyst and lead reduction to below EPA standards; with capacity sized for unit peak flow rate.
9. Cooling System: Electric, with hermetically sealed compressor, cooling coil, air-cooled condensing unit, corrosion-resistant tubing, refrigerant, corrosion-resistant-metal storage tank, and adjustable thermostat.

   a. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

10. Capacities and Characteristics: See schedule.
11. Support: Type I Water Cooler Carrier or Type II Water Cooler Carrier.
12. Water Cooler Mounting Height: Standard and Handicapped/elderly according to ICC A117.1.

2.2 SUPPORTS

A. Type I Water Cooler Carrier:

1. Standard: ASME A112.6.1M.

B. Type II Water Cooler Carrier:

1. Standard: ASME A112.6.1M.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in for water-supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before fixture installation.

B. Examine walls and floors for suitable conditions where fixtures will be installed.

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

3.2 INSTALLATION

A. Install fixtures level and plumb according to roughing-in drawings. For fixtures indicated for children, install at height required by authorities having jurisdiction.

B. Set freestanding pressure water coolers on floor.

C. Install off-the-floor carrier supports, affixed to building substrate, for wall-mounted fixtures.

D. Install mounting frames, affixed to building construction, and attach recessed, pressure water coolers, and in-wall bottle filling stations to mounting frames.

E. Install water-supply piping with shutoff valve on supply to each fixture to be connected to domestic-water distribution piping. Use ball or gate valve. Install valves in locations where they can be easily reached for operation. Valves are specified in Section 220523.12 "Ball Valves for Plumbing Piping" and Section 220523.15 "Gate Valves for Plumbing Piping."

F. Install trap and waste piping on drain outlet of each fixture to be connected to sanitary drainage system.

G. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons where required to conceal protruding fittings. Comply with escutcheon requirements specified in Section 220518 "Escutcheons for Plumbing Piping."

H. Seal joints between fixtures and walls using sanitary-type, one-part, mildew-resistant, silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified in Section 079200 "Joint Sealants."

3.3 CONNECTIONS

A. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.

B. Comply with water piping requirements specified in Section 221116 "Domestic Water Piping."

C. Install ball or gate shutoff valve on water supply to each fixture. Comply with valve requirements specified in Section 220523.12 "Ball Valves for Plumbing Piping" and Section 220523.15 "Gate Valves for Plumbing Piping."

D. Comply with soil and waste piping requirements specified in Section 221316 "Sanitary Waste and Vent Piping."

3.4 ADJUSTING

A. Adjust fixture flow regulators for proper flow and stream height.

B. Adjust pressure water-cooler temperature settings.

3.5 CLEANING

A. After installing fixture, inspect unit. Remove paint splatters and other spots, dirt, and debris. Repair damaged finish to match original finish.

B. Clean fixtures, on completion of installation, according to manufacturer's written instructions.

C. Provide protective covering for installed fixtures.

D. Do not allow use of fixtures for temporary facilities unless approved in writing by Owner.

END OF SECTION 224716

SECTION 23 05 13 – COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes general requirements for polyphase, general-purpose, horizontal, small and medium, squirrel-cage induction motors for use on ac power systems up to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.

1.2 SUBMITTALS

A. Specification Compliance: An electronic copy of the specification will be provided to vendors for their responses. Each vendor shall indicate one of the following on every specification requirement paragraph-by-paragraph:

1. Comply - vendor complies or exceeds this requirement.
2. Deviation - vendor deviated from this requirement, but provides similar operational and functional capability. Vendor to describe the deviation and how its product meets the specification performance requirement.
3. Non-Compliant - vendor's proposed product does not meet the specification requirement.

B. Product Data for Motors: For each type and size of motor, provide nameplate data and ratings; shipping, installed, and operating weights; enclosure type and mounting arrangements; size, type, and location of winding terminations; conduit entry and ground lug locations; and information on coatings or finishes.

1.3 QUALITY ASSURANCE

A. Source Limitations: Obtain motors through one source from a single manufacturer.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with NFPA 70.

1.4 COORDINATION

A. Coordinate features of motors, installed units, and accessory devices and features that comply with the following:

1. Compatible with the following:

   a. Magnetic controllers.
   b. Multispeed controllers.
   c. Reduced-voltage controllers.

2. Designed and labeled for use with variable frequency controllers, and suitable for use throughout speed range without overheating.

3. Matched to torque and horsepower requirements of the load.
4. Matched to ratings and characteristics of supply circuit and required control sequence.
5. Ambient and environmental conditions of installation location.

B. Coordinate motor support with requirements for driven load; access for maintenance and motor replacement; installation of accessories, belts, belt guards; and adjustment of sliding rails for belt tensioning.

C. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified below.

   a. Baldor
   b. General Electric
   c. Reliance
   d. US Motor

2.2 MOTOR REQUIREMENTS

A. Motor requirements apply to factory- and field-installed motors except as follows:

1. Different ratings, performance, or characteristics for motor are specified in another Section.
2. Motorized-equipment manufacturer requires ratings, performance, or characteristics, other than those specified in this Section, to meet performance specified.

2.3 MOTOR CHARACTERISTICS

A. Motors 3/4 HP and Larger: Three phase.

B. Frequency Rating: 60 Hz.

C. Voltage Rating: NEMA standard voltage selected to operate on nominal circuit voltage to which motor is connected.

D. Service Factor: 1.15 for open drip-proof motors; 1.15 for totally enclosed motors.

E. Duty: Continuous duty at ambient temperature of 105 deg F and at altitude of 3300 feet above sea level.

F. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

2.4 POLYPHASE MOTORS

A. Description: NEMA MG 1, Design B, medium induction motor.

B. Efficiency: Premium, as defined in NEMA MG 1.

C. Stator: Copper windings, unless otherwise indicated.

1. Multispeed motors shall have separate winding for each speed.

D. Rotor: Squirrel cage, unless otherwise indicated.

E. Bearings: Double-shielded, prelubricated ball bearings suitable for radial and thrust loading.

F. Temperature Rise: Match insulation rating, unless otherwise indicated.

G. Insulation: Class F, unless otherwise indicated.

2.5 POLYPHASE MOTORS WITH ADDITIONAL REQUIREMENTS

A. Motors Used with Reduced-Inrush Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.

B. Motors Used with Variable Frequency Controllers: Ratings, characteristics, and features coordinated with and approved by controller manufacturer.

1. Designed with critical vibration frequencies outside operating range of controller output.
2. Temperature Rise: Matched to rating for Class B insulation.
3. Insulation: Class H and in accordance with NEMA MG1 Part 31 Standards.
4. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.
5. For motors 10 hp and larger: Provide motor shaft grounding.
6. For motors 100 hp and larger: Provide insulated bearings in addition to motor shaft grounding.

C. Rugged-Duty Motors: Totally enclosed, with 1.25 minimum service factor, greased bearings, integral condensate drains, and capped relief vents. Windings insulated with non-hygroscopic material.

1. Finish: Chemical-resistant paint over corrosion-resistant primer.

D. Source Quality Control for Field-Installed Motors: Perform the following tests on each motor according to NEMA MG 1:

1. Measure winding resistance.
2. Read no-load current and speed at rated voltage and frequency.
3. Measure locked rotor current at rated frequency.
4. Perform high-potential test.

PART 3 - EXECUTION

3.1 Not Applicable.

END OF SECTION 23 05 13

SECTION 23 05 17 - SLEEVES AND SLEEVE SEALS FOR HVAC PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Sleeves.
2. Stack-sleeve fittings.
3. Sleeve-seal fittings.
4. Grout.

1.2 SUBMITTALS

A. Product Data: For each type of product indicated.

PART 2 - PRODUCTS

2.1 SLEEVES

A. Galvanized-Steel-Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, with plain ends.

B. Galvanized-Steel-Sheet Sleeves: 0.0239-inchminimum thickness; round tube closed with welded longitudinal joint.

C. Molded-PE or -PP Sleeves: Removable, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.

2.2 STACK-SLEEVE FITTINGS

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

1. Smith, Jay R. Mfg. Co.
2. Zurn Specification Drainage Operation; Zurn Plumbing Products Group.

.

B. Description: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring, bolts, and nuts for membrane flashing.

1. Underdeck Clamp: Clamping ring with setscrews.

2.3 SLEEVE-SEAL FITTINGS

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

1. Presealed Systems.
.

B. Description: Manufactured plastic, sleeve-type, waterstop assembly made for imbedding in concrete slab or wall. Unit has plastic or rubber waterstop collar with center opening to match piping OD.

2.4 GROUT

A. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.

B. Characteristics: Nonshrink; recommended for interior and exterior applications.

C. Design Mix: 5000-psi, 28-day compressive strength.

D. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 SLEEVE INSTALLATION

A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.

B. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide 1-inch annular clear space between piping and concrete slabs and walls.

1. Sleeves are not required for core-drilled holes.

C. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.

1. Permanent sleeves are not required for holes in slabs formed by molded-PE or -PP sleeves.
2. 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.

3. Using grout, seal the space outside of sleeves in slabs and walls without sleeve-seal system.

D. Install sleeves for pipes passing through interior partitions.

1. Cut sleeves to length for mounting flush with both surfaces.
2. Install sleeves that are large enough to provide 1/4-inchannular clear space between sleeve and pipe or pipe insulation.

3. Seal annular space between sleeve and piping or piping insulation; use joint sealants appropriate for size, depth, and location of joint. Comply with requirements for sealants specified in Division 07 Section "Joint Sealants."

E. 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 firestopping specified in Division 07 Section "Penetration Firestopping."

3.2 STACK-SLEEVE-FITTING INSTALLATION

A. Install stack-sleeve fittings in new slabs as slabs are constructed.

1. Install fittings that are large enough to provide 1/4-inchannular clear space between sleeve and pipe or pipe insulation.
2. Secure flashing between clamping flanges for pipes penetrating floors with membrane waterproofing. Comply with requirements for flashing specified in Division 07 Section "Sheet Metal Flashing and Trim."
3. Install section of cast-iron soil pipe to extend sleeve to 2 inchesabove finished floor level.
4. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
5. Using grout, seal the space around outside of stack-sleeve fittings.

3.3 SLEEVE-SEAL-FITTING INSTALLATION

A. Install sleeve-seal fittings in new walls and slabs as they are constructed.

B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange to be centered in concrete slab or wall.

C. Secure nailing flanges to concrete forms.

D. Using grout, seal the space around outside of sleeve-seal fittings.

3.4 SLEEVE AND SLEEVE-SEAL SCHEDULE

A. Use sleeves and sleeve seals for the following piping-penetration applications:

1. Exterior Concrete Walls above Grade:

   a. Piping Smaller Than NPS 6: Galvanized-steel-pipe sleeves.
   b. Piping NPS 6 and Larger: Galvanized-steel wall sleeves.

2. Exterior Concrete Walls below Grade:

   a. Piping Smaller Than NPS 6: Galvanized-steel-pipe sleeves with sleeve-seal system.

      1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.

   b. Piping NPS 6 and Larger: Galvanized-steel-pipe sleeves with sleeve-seal system.

1) Select sleeve size to allow for 1-inchannular clear space between piping and sleeve for installing sleeve-seal system.

3. Concrete Slabs above Grade:

   a. Piping Smaller Than NPS 6: Galvanized-steel-pipe sleeves.
   b. Piping NPS 6 and Larger: Galvanized-steel-pipe sleeves.

4. Interior Partitions:

   a. Piping Smaller Than NPS 6: Galvanized-steel-pipe sleeves.
   b. Piping NPS 6 and Larger: Galvanized-steel-sheet sleeves.

END OF SECTION 23 05 17

SECTION 23 05 18 - ESCUTCHEONS FOR HVAC PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Escutcheons.

1.2 SUBMITTALS

A. Product Data: For each type of product indicated.

PART 2 - PRODUCTS

2.1 ESCUTCHEONS

A. One-Piece, Stamped-Steel Type: With chrome-plated finish and spring-clip fasteners.

B. Split-Casting Brass Type: With polished, chrome-plated rough-brass finish and with concealed hinge and setscrew.

C. Split-Plate, Stamped-Steel Type: With chrome-plated finish, concealed hinge, and spring-clip fasteners.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install escutcheons for piping penetrations of walls, ceilings, and finished floors.

B. Install escutcheons with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.

1. Escutcheons for New Piping:

a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
b. Chrome-Plated Piping: One-piece, cast-brass or split-casting brass type with polished, chrome-plated finish.
c. Insulated Piping: One-piece, stamped-steel type or split-plate, stamped-steel type with concealed hinge.
d. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, cast-brass or split-casting brass type with polished, chrome-plated finish.

e. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, stamped-steel type or split-plate, stamped-steel type with concealed hinge or split-plate, stamped-steel type with exposed-rivet hinge.
f. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass or split-casting brass type with polished, chrome-plated finish.
g. Bare Piping in Unfinished Service Spaces: One-piece, stamped-steel type or split-plate, stamped-steel type with concealed hinge.
h. Bare Piping in Equipment Rooms: One-piece, cast-brass or split-casting brass type with polished, chrome-plated finish.
i. Bare Piping in Equipment Rooms: One-piece, stamped-steel type or split-plate, stamped-steel type with concealed hinge or split-plate, stamped-steel type with exposed-rivet hinge.

3.2 FIELD QUALITY CONTROL

A. Replace broken and damaged escutcheons and floor plates using new materials.

END OF SECTION 23 05 18

SECTION 23 05 29 - HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Trapeze pipe hangers.
2. Pipe stands.
3. Equipment supports.

B. Related Sections:

1. Division 05 Section "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
2. Division 23 Section "Expansion Fittings and Loops for HVAC Piping" for pipe guides and anchors.
3. Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment" for vibration isolation devices.
4. Division 23 Section(s) "Metal Ducts" and "Nonmetal Ducts" for duct hangers and supports.

1.2 DEFINITIONS

A. MSS: Manufacturers Standardization Society of The Valve and Fittings Industry Inc.

1.3 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design trapeze pipe hangers and equipment supports, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. Structural Performance: Hangers and supports for HVAC piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.

1. Design supports for multiple pipes, including pipe stands, 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.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: Show fabrication and installation details and include calculations for the following; include Product Data for components:

1. Trapeze pipe hangers.
2. Pipe stands.
3. Equipment supports.

1.5 QUALITY ASSURANCE

PEX pipe within plenum space must be hung and supported in accordance with plenum rating of pipe manufacturers listing.

PART 2 - PRODUCTS

2.1 HDPE AND PEX PIPE HANGERS AND SUPPORTS

A. HDPE and PEX Pipe Hangers and Supports:

1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
2. Galvanized Metallic Coatings: Pre-galvanized 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.

2.2 TRAPEZE PIPE HANGERS

A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural carbon-steel shapes with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts.

2.3 PIPE STANDS

A. General Requirements for Pipe Stands: 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.

C. Curb-Mounted-Type Pipe Stands: Shop- or field-fabricated pipe supports made from structural-steel shapes, continuous-thread rods, and rollers, for mounting on permanent stationary roof curb.

2.4 EQUIPMENT SUPPORTS

A. Description: Welded, shop- or field-fabricated equipment support made from structural carbon-steel shapes.

2.5 MISCELLANEOUS MATERIALS

A. Structural Steel: ASTM A 36/A 36M, carbon-steel plates, shapes, and bars; black and galvanized.

B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.

1. Properties: Nonstaining, noncorrosive, and nongaseous.
2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT INSTALLATION

A. Metal 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. 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.
2. Comply with PEX pipe manufacturer's instructions for plenum listing.

B. Pipe Stand Installation:

C. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.

D. Install hangers and supports to allow controlled thermal movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

E. Install lateral bracing with pipe hangers and supports to prevent swaying.

F. 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.

G. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

H. 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.

I. 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.

3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.

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.

3.2 EQUIPMENT SUPPORTS

A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.

B. Grouting: Place grout under supports for equipment and make bearing surface smooth.

C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.3 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.

3.4 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 metal, trapeze pipe hangers and metal framing systems and attachments for general service applications.

F. Use copper-plated pipe hangers and copper attachments for copper piping and tubing.

G. 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 non-insulated or insulated, stationary pipes NPS 1/2 to NPS 4.
2. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30.
3. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes NPS 2-1/2 to NPS 4, from single rod if horizontal movement caused by expansion and contraction might occur.

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.

I. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction, to attach to top flange of structural shape.
2. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
3. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
4. C-Clamps (MSS Type 23): For structural shapes.
5. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
6. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.

J. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to meet plenum rating.

K. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.

L. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.

END OF SECTION 23 05 29

SECTION 23 05 48 - VIBRATION CONTROLS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Isolation pads.
2. Housed spring mounts.
3. Spring hangers.

1.2 DEFINITIONS

A. IBC: International Building Code.

1.3 SUBMITTALS

A. Product Data: For the following:

1. Include rated load, rated deflection, and overload capacity for each vibration isolation device.

   a. Annotate to indicate application of each product submitted and compliance with requirements.

B. Field quality-control test reports.

1.4 QUALITY ASSURANCE

A. Maintain ASHRAE criteria for average noise criteria curves for all equipment at full load condition.

PART 2 - PRODUCTS

2.1 VIBRATION ISOLATORS

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

1. Ace Mountings Co., Inc.
2. Amber/Booth Company, Inc.
3. Isolation Technology, Inc.
4. Kinetics Noise Control.
5. Mason Industries.
6. Vibration Eliminator Co., Inc.

7. Vibration Isolation.
8. Vibration Mountings & Controls, Inc.

B. Pads: Arranged in single or multiple layers of sufficient stiffness for uniform loading over pad area, molded with a nonslip pattern and galvanized-steel baseplates, and factory cut to sizes that match requirements of supported equipment.

1. Resilient Material: Oil- and water-resistant neoprene.

C. Mounts: Double-deflection type, with molded, oil-resistant rubber, hermetically sealed compressed fiberglass, or neoprene isolator elements with factory-drilled, encapsulated top plate for bolting to equipment and with baseplate for bolting to structure. Color-code or otherwise identify to indicate capacity range.

1. Materials: Cast-ductile-iron or welded steel housing containing two separate and opposing, oil-resistant rubber or neoprene elements that prevent central threaded element and attachment hardware from contacting the housing during normal operation.
2. Neoprene: Shock-absorbing materials compounded according to the standard for bridge-bearing neoprene as defined by AASHTO.

D. Restrained Spring Isolators: Freestanding, steel, open-spring isolators with limit-stop restraint.

1. Housing: Steel with resilient vertical-limit stops to prevent spring extension due to weight being removed; factory-drilled baseplate bonded to 1/4-inch-thick, neoprene or rubber isolator pad attached to baseplate underside; and adjustable equipment mounting and leveling bolt that acts as blocking during installation.
2. Restraint: Seismic or limit stop as required for equipment and authorities having jurisdiction.
3. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
4. Minimum Additional Travel: 50 percent of the required deflection at rated load.
5. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
6. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

E. Housed Spring Mounts: Housed spring isolator with integral snubbers.

1. Housing: Ductile-iron or steel housing to provide all-directional seismic restraint.
2. Base: Factory drilled for bolting to structure.
3. Snubbers: Vertically adjustable to allow a maximum of 1/4-inch travel up or down before contacting a resilient collar.

F. Elastomeric Hangers: Single or double-deflection type, fitted with molded, oil-resistant elastomeric isolator elements bonded to steel housings with threaded connections for hanger rods. Color-code or otherwise identify to indicate capacity range.

G. Spring Hangers with Vertical-Limit Stop: Combination coil-spring and elastomeric-insert hanger with spring and insert in compression and with a vertical-limit stop.

1. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.
2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
3. Minimum Additional Travel: 50 percent of the required deflection at rated load.

4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
6. Elastomeric Element: Molded, oil-resistant rubber or neoprene.
7. Adjustable Vertical Stop: Steel washer with neoprene washer "up-stop" on lower threaded rod.
8. Self-centering hanger rod cap to ensure concentricity between hanger rod and support spring coil.

H. Pipe Riser Resilient Support: All-directional, acoustical pipe anchor consisting of 2 steel tubes separated by a minimum of 1/2-inch-thick neoprene. Include steel and neoprene vertical-limit stops arranged to prevent vertical travel in both directions. Design support for a maximum load on the isolation material of 500 psig and for equal resistance in all directions.

I. Resilient Pipe Guides: Telescopic arrangement of 2 steel tubes or post and sleeve arrangement separated by a minimum of 1/2-inch-thick neoprene. Where clearances are not readily visible, a factory-set guide height with a shear pin to allow vertical motion due to pipe expansion and contraction shall be fitted. Shear pin shall be removable and reinsertable to allow for selection of pipe movement. Guides shall be capable of motion to meet location requirements.

2.2 VIBRATION ISOLATION EQUIPMENT BASES

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:

1. Amber/Booth Company, Inc.
2. Isolation Technology, Inc.
3. Kinetics Noise Control.
4. Mason Industries.
5. Vibration Eliminator Co., Inc.
6. Vibration Isolation.
7. Vibration Mountings & Controls, Inc.

B. Inertia Base: Factory-fabricated, welded, structural-steel bases and rails ready for placement of cast-in-place concrete.

1. Design Requirements: Lowest possible mounting height with not less than 1-inch clearance above the floor. Include equipment anchor bolts and auxiliary motor slide bases or rails.

   a. Include supports for suction and discharge elbows for pumps.

2. Structural Steel: Steel shapes, plates, and bars complying with ASTM A 36/A 36M. Bases shall have shape to accommodate supported equipment.
3. Support Brackets: Factory-welded steel brackets on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.
4. Fabrication: Fabricate steel templates to hold equipment anchor-bolt sleeves and anchors in place during placement of concrete. Obtain anchor-bolt templates from supported equipment manufacturer.

2.3 FACTORY FINISHES

A. Finish: Manufacturer's standard prime-coat finish ready for field painting.

B. Finish: Manufacturer's standard paint applied to factory-assembled and -tested equipment before shipping.

1. Powder coating on springs and housings.
2. All hardware shall be galvanized. Hot-dip galvanize metal components for exterior use.
3. Baked enamel or powder coat for metal components on isolators for interior use.
4. Color-code or otherwise mark vibration isolation and wind-control devices to indicate capacity range.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and equipment to receive vibration isolation and wind-control devices for compliance with requirements for installation tolerances and other conditions affecting performance.

B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.

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

3.2 APPLICATIONS

A. Hanger Rod Stiffeners: Install hanger rod stiffeners where indicated or scheduled on Drawings to receive them and where required to prevent buckling of hanger rods due to seismic forces.

B. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static.

3.3 VIBRATION-CONTROL RESTRAINT DEVICE INSTALLATION

A. Comply with requirements in Division 07 Section "Roof Accessories" for installation of roof curbs, equipment supports, and roof penetrations.

B. Equipment Restraints:

1. Install seismic snubbers on HVAC equipment mounted on vibration isolators. Locate snubbers as close as possible to vibration isolators and bolt to equipment base and supporting structure.
2. Install resilient bolt isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch.
3. Install seismic-restraint devices using methods approved by providing required submittals for component.

C. Piping Restraints:

1. Comply with requirements in MSS SP-127.
2. Space lateral supports a maximum of 40 feet o.c., and longitudinal supports a maximum of 80 feet o.c.
3. Brace a change of direction longer than 12 feet.

D. Install cables so they do not bend across edges of adjacent equipment or building structure.

E. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.

F. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.

G. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.

H. Drilled-in Anchors:

1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
4. Adhesive Anchors: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.
5. Set anchors to manufacturer's recommended torque, using a torque wrench.
6. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

3.4 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:

1. Measure isolator restraint clearance.
2. Measure isolator deflection.
3. Verify snubber minimum clearances.

C. Remove and replace malfunctioning units and retest as specified above.

3.5 ADJUSTING

A. Adjust isolators after piping system is at operating weight.

B. Adjust limit stops on restrained spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.

C. Adjust active height of spring isolators.

D. Adjust restraints to permit free movement of equipment within normal mode of operation.

END OF SECTION 23 05 48

SECTION 23 05 53 - IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Equipment labels.
2. Warning signs and labels.
3. Pipe labels.
4. Duct labels.
5. Stencils.
6. Valve tags.
7. Warning tags.

1.2 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Valve numbering scheme.

1.3 COORDINATION

A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

B. Coordinate installation of identifying devices with locations of access panels and doors.

C. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

A. Metal Labels for Equipment:

1. Material and Thickness: Brass, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
2. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
3. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
4. Fasteners: Stainless-steel rivets.
5. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Plastic Labels for Equipment:

1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.
2. Letter Color: White.
3. Background Color: Black.
4. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
6. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
7. Fasteners: Stainless-steel rivets.
8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

C. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified.

D. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.2 WARNING SIGNS AND LABELS

A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.

B. Letter Color: Black.

C. Background Color: Yellow.

D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.

E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

F. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

G. Fasteners: Stainless-steel rivets.

H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

I. Label Content: Include caution and warning information, plus emergency notification instructions.

2.3 PIPE LABELS

A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.

B. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.

C. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.

D. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.

1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions, or as separate unit on each pipe label to indicate flow direction.
2. Lettering Size: At least 1-1/2 inches high.

2.4 DUCT LABELS

A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.

B. Letter Color: White.

C. Background Color: Black.

D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.

E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

F. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

G. Fasteners: Stainless-steel rivets.

H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

I. Duct Label Contents: Include identification of duct service using same designations or abbreviations as used on Drawings, duct size, and an arrow indicating flow direction.

1. Flow-Direction Arrows: Integral with duct system service lettering to accommodate both directions, or as separate unit on each duct label to indicate flow direction.
2. Lettering Size: At least 1-1/2 inches high.

2.5 STENCILS

A. Stencils: Prepared with letter sizes according to ASME A13.1 for piping; minimum letter height of 1-1/4 inches for ducts; and minimum letter height of 3/4 inch for access panel and door labels, equipment labels, and similar operational instructions.

1. Stencil Material: Fiberboard or metal.

2. Stencil Paint: Exterior, gloss, acrylic enamel black unless otherwise indicated. Paint may be in pressurized spray-can form.
3. Identification Paint: Exterior, acrylic enamel in colors according to ASME A13.1 unless otherwise indicated.

2.6 VALVE TAGS

A. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers.

1. Tag Material: Brass, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
2. Fasteners: Brass wire-link or beaded chain; or S-hook.

B. Valve Schedules: For each piping system, on 8-1/2-by-11-inch bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.

1. Valve-tag schedule shall be included in operation and maintenance data.

2.7 WARNING TAGS

A. Warning Tags: Preprinted or partially preprinted, accident-prevention tags, of plasticized card stock with matte finish suitable for writing.

1. Size: Approximately 4 by 7 inches.
2. Fasteners: Brass grommet and wire.
3. Nomenclature: Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT OPERATE."
4. Color: Yellow background with black lettering.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 EQUIPMENT LABEL INSTALLATION

A. Install or permanently fasten labels on each major item of mechanical equipment.

B. Locate equipment labels where accessible and visible.

3.3 PIPE LABEL INSTALLATION

A. Piping Color-Coding: Painting of piping is specified in Division 09 Section "."

B. Stenciled Pipe Label Option: Stenciled labels may be provided instead of manufactured pipe labels, at Installer's option. Install stenciled pipe labels , complying with ASME A13.1, on each piping system.

1. Identification Paint: Use for contrasting background.
2. Stencil Paint: Use for pipe marking.

C. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:

1. Near each valve and control device.
2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
4. At access doors, manholes, and similar access points that permit view of concealed piping.
5. Near major equipment items and other points of origination and termination.
6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.

D. Pipe Label Color Schedule:

1. Condenser-Water Piping:

a. Background Color: White.
b. Letter Color: Blue.

3.4 DUCT LABEL INSTALLATION

A. Install self-adhesive duct labels with permanent adhesive on air ducts in the following color codes:

1. Blue: For cold-air supply ducts.
2. Yellow: For hot-air supply ducts.
3. Green: For exhaust-, outside-, relief-, return-, and mixed-air ducts.
4. ASME A13.1 Colors and Designs: For hazardous material exhaust.

B. Stenciled Duct Label Option: Stenciled labels, showing service and flow direction, may be provided instead of plastic-laminated duct labels, at Installer's option, if lettering larger than 1 inch high is needed for proper identification because of distance from normal location of required identification.

C. Locate labels near points where ducts enter into concealed spaces and at maximum intervals of 50 feet in each space where ducts are exposed or concealed by removable ceiling system.

3.5 VALVE-TAG INSTALLATION

A. Install tags on valves and control devices in piping systems, except check valves; valves within factory-fabricated equipment units; shutoff valves; faucets; convenience and lawn-watering hose connections; and HVAC terminal devices and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.

B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in the following subparagraphs:

1. Valve-Tag Size and Shape:
   a. Condenser Water: 1-1/2 inches, round.

2. Valve-Tag Color:
   a. Condenser Water: Green.

3. Letter Color:
   a. Condenser Water: White.

3.6 WARNING-TAG INSTALLATION

A. Write required message on, and attach warning tags to, equipment and other items where required.

END OF SECTION 23 05 53

SECTION 23 05 93 - TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Balancing Air Systems:

a. Constant-volume air systems.

2. Balancing Hydronic Piping Systems:

a. Constant-flow hydronic systems.
b. Variable-flow hydronic systems.

1.2 DEFINITIONS

A. AABC: Associated Air Balance Council.

B. NEBB: National Environmental Balancing Bureau.

C. TAB: Testing, adjusting, and balancing.

D. TABB: Testing, Adjusting, and Balancing Bureau.

E. TAB Specialist: An entity engaged to perform TAB Work.

1.3 SUBMITTALS

A. Qualification Data: Within 30 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 30 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.

1.4 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 Report Forms: Use standard TAB contractor's forms approved by Commissioning Authority.

C. Instrumentation Type, Quantity, Accuracy, and Calibration: As described in ASHRAE 111, Section 5, "Instrumentation."

1.5 PROJECT CONDITIONS

A. 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.

1.6 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.

C. The preparation for and corrections necessary for the testing, adjusting and balancing of these systems, as described herein, are the responsibility of this contractor.

D. As part of this project Construction Contract, the contractor shall make any changes or replacement to the sheaves, belts, dampers, valves, etc. required for correct balance as advised by the TAB Firm, at no additional cost to the owner.

E. Contractor shall provide and coordinate the services of qualified, responsible subcontractors, suppliers and personnel as required to correct, repair and/or replace any and all deficient items or conditions found during the course of this project, including during the testing and adjusting and balancing period.

F. In order that system may be properly tested, adjusted, and balanced, the Contractor shall operate system at Contractor’s expense for the length of time necessary to properly verify the systems’ completion and readiness for TAB.

G. Project Contract completion schedules shall allow for sufficient time to permit the completion of TAB services prior to Owner occupancy. Contractor shall allow adequate time for the testing and balancing activities during the construction period and prior to the Substantial Completion as defined in this Construction Documents.

H. The drawings and specifications indicate valves, damper and miscellaneous adjustment devices for the purpose of adjustment to obtain optimum operating conditions. Contractor shall be responsible for installing these devices in a manner that will leave the devices accessible and readily able to be adjusted. Contractor shall immediately correct any malfunction encountered and reported to the Contractor by TAB personnel so that the balancing work can proceed with minimum delay.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 TAB SPECIALISTS

A. Subject to compliance with requirements, Testing, Adjusting and Balancing (TAB) of the air conditioning systems and domestic water systems will be performed by an impartial technical TAB firm employed by the contractor, engage one of the following:

1. Engineering Air Balance, Inc.
2. Technical Air Balance, Inc.
3. Precision Air of Texas
4. Any TAB firm approved by the engineer providing equal or better quality of work as the firms above.

3.2 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 system pumps to ensure absence of entrained air in the suction piping.

M. Examine operating safety interlocks and controls on HVAC equipment.

N. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

3.3 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.

3.4 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 62.1-2007, 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."

C. Mark equipment and balancing devices, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, with paint or other suitable, permanent identification material to show final settings.

D. Take and report testing and balancing measurements in inch-pound (IP) units.

3.5 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. Determine the best locations in main and branch ducts for accurate duct-airflow measurements.

D. 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.

E. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.

F. Verify that motor starters are equipped with properly sized thermal protection.

G. Check dampers for proper position to achieve desired airflow path.

H. Check for airflow blockages.

I. Check condensate drains for proper connections and functioning.

J. Check for proper sealing of air-handling-unit components.

K. Verify that air duct system is sealed as specified in Division 23 Section "Metal Ducts."

3.6 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 Architect Owner 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.

3.7 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.

3.8 PROCEDURES FOR CONSTANT-FLOW HYDRONIC SYSTEMS

A. Measure water flow at pumps. Use the following procedures except for positive-displacement pumps:

1. Verify impeller size by operating the pump with the discharge valve closed. Read pressure differential across the pump. Convert pressure to head and correct for differences in gage heights. Note the point on manufacturer's pump curve at zero flow and verify that the pump has the intended impeller size.

   a. If impeller sizes must be adjusted to achieve pump performance, obtain approval from Architect and comply with requirements in Division 23 Section "Hydronic Pumps."

2. Check system resistance. With all valves open, read pressure differential across the pump and mark pump manufacturer's head-capacity curve. Adjust pump discharge valve until indicated water flow is achieved.

   a. Monitor motor performance during procedures and do not operate motors in overload conditions.

3. Verify pump-motor brake horsepower. Calculate the intended brake horsepower for the system based on pump manufacturer's performance data. Compare calculated brake horsepower with nameplate data on the pump motor. Report conditions where actual amperage exceeds motor nameplate amperage.
4. Report flow rates that are not within plus or minus 10 percent of design.

B. Measure flow at all automatic flow control valves to verify that valves are functioning as designed.

C. Measure flow at all pressure-independent characterized control valves, with valves in fully open position, to verify that valves are functioning as designed.

D. Set calibrated balancing valves, if installed, at calculated presettings.

E. Measure flow at all stations and adjust, where necessary, to obtain first balance.

1. System components that have Cv rating or an accurately cataloged flow-pressure-drop relationship may be used as a flow-indicating device.

F. Measure flow at main balancing station and set main balancing device to achieve flow that is 5 percent greater than indicated flow.

G. Adjust balancing stations to within specified tolerances of indicated flow rate as follows:

1. Determine the balancing station with the highest percentage over indicated flow.
2. Adjust each station in turn, beginning with the station with the highest percentage over indicated flow and proceeding to the station with the lowest percentage over indicated flow.
3. Record settings and mark balancing devices.

H. Measure pump flow rate and make final measurements of pump amperage, voltage, rpm, pump heads, and systems' pressures and temperatures including outdoor-air temperature.

I. Measure the differential-pressure-control-valve settings existing at the conclusion of balancing.

J. Check settings and operation of each safety valve. Record settings.

3.9 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.

3.10 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.

3.11 PROCEDURES FOR COOLING TOWERS

A. Shut off makeup water for the duration of the test, and verify that makeup and blowdown systems are fully operational after tests and before leaving the equipment. Perform the following tests and record the results:

1. Measure condenser-water flow to each cell of the cooling tower.
2. Measure entering- and leaving-water temperatures.
3. Measure wet- and dry-bulb temperatures of entering air.
4. Measure wet- and dry-bulb temperatures of leaving air.
5. Measure condenser-water flow rate recirculating through the cooling tower.
6. Measure cooling-tower spray pump discharge pressure.
7. Adjust water level and feed rate of makeup water system.
8.

3.12 PROCEDURES FOR CONDENSING UNITS

A. Measure entering- and leaving-air temperatures.

B. Record compressor data.

3.13 PROCEDURES FOR HEAT-TRANSFER COILS

A. Measure, adjust, and record the following data for each water coil:

1. Entering- and leaving-water temperature.
2. Water flow rate.
3. Water pressure drop.
4. Dry-bulb temperature of entering and leaving air.
5. Wet-bulb temperature of entering and leaving air for cooling coils.
6. Airflow.
7. Air pressure drop.

B. Measure, adjust, and record the following data for each electric heating coil:

1. Nameplate data.
2. Airflow.
3. Entering- and leaving-air temperature at full load.
4. Voltage and amperage input of each phase at full load and at each incremental stage.
5. Calculated kilowatt at full load.
6. Fuse or circuit-breaker rating for overload protection.

C. Measure, adjust, and record the following data for each steam coil:

1. Dry-bulb temperature of entering and leaving air.
2. Airflow.
3. Air pressure drop.
4. Inlet steam pressure.

D. Measure, adjust, and record the following data for each refrigerant coil:

1. Dry-bulb temperature of entering and leaving air.
2. Wet-bulb temperature of entering and leaving air.
3. Airflow.
4. Air pressure drop.
5. Refrigerant suction pressure and temperature.

3.14 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.

3.15 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 biweekly 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.

3.16 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, and bore.
    i. Center-to-center dimensions of sheave, and amount of adjustments in inches.
    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, and bore.
   f. Center-to-center dimensions of sheave, and amount of adjustments in inches.

3. Test Data (Indicated and Actual Values):

   a. Total air flow rate in cfm.
   b. Total system static pressure in inches wg.
   c. Fan rpm.
   d. Discharge static pressure in inches wg.
   e. Filter static-pressure differential in inches wg.
   f. Preheat-coil static-pressure differential in inches wg.
   g. Cooling-coil static-pressure differential in inches wg.
   h. Heating-coil static-pressure differential in inches wg.
   i. Outdoor airflow in cfm.
   j. Return airflow in cfm.
   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 o.c.
   f. Make and model number.
   g. Face area in sq. ft..
   h. Tube size in NPS.
   i. Tube and fin materials.
   j. Circuiting arrangement.

2. Test Data (Indicated and Actual Values):

   a. Air flow rate in cfm.
   b. Average face velocity in fpm.
   c. Air pressure drop in inches wg.
   d. Outdoor-air, wet- and dry-bulb temperatures in deg F.
   e. Return-air, wet- and dry-bulb temperatures in deg F.
   f. Entering-air, wet- and dry-bulb temperatures in deg F.
   g. Leaving-air, wet- and dry-bulb temperatures in deg F.
   h. Water flow rate in gpm.
   i. Water pressure differential in feet of head or psig.
   j. Entering-water temperature in deg F.
   k. Leaving-water temperature in deg F.
   l. Refrigerant expansion valve and refrigerant types.
   m. Refrigerant suction pressure in psig.
   n. Refrigerant suction temperature in deg F.

o. Inlet steam pressure in psig.

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.
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, and bore.
n. Center-to-center dimensions of sheave, and amount of adjustments in inches.

2. Test Data (Indicated and Actual Values):

a. Total air flow rate in cfm.
b. Entering-air temperature in deg F.
c. Leaving-air temperature in deg F.
d. Air temperature differential in deg F.
e. Entering-air static pressure in inches wg.
f. Leaving-air static pressure in inches wg.
g. Air static-pressure differential in inches wg.
h. Low-fire fuel input in Btu/h.
i. High-fire fuel input in Btu/h.
j. Manifold pressure in psig.
k. High-temperature-limit setting in deg F.
l. Operating set point in Btu/h.
m. Motor voltage at each connection.
n. Motor amperage for each phase.
o. Heating value of fuel in Btu/h.

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, and bore.
h. Center-to-center dimensions of sheave, and amount of adjustments in inches.

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, and bore.
f. Center-to-center dimensions of sheave, and amount of adjustments in inches.
g. Number, make, and size of belts.

3. Test Data (Indicated and Actual Values):

a. Total airflow rate in cfm.
b. Total system static pressure in inches wg.
c. Fan rpm.
d. Discharge static pressure in inches wg.
e. Suction static pressure in inches wg.

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.
d. Duct static pressure in inches wg.
e. Duct size in inches.
f. Duct area in sq. ft..
g. Indicated air flow rate in cfm.
h. Indicated velocity in fpm.
i. Actual air flow rate in cfm.
j. Actual average velocity in fpm.
k. Barometric pressure in psig.

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..

2. Test Data (Indicated and Actual Values):

a. Air flow rate in cfm.
b. Air velocity in fpm.
c. Preliminary air flow rate as needed in cfm.
d. Preliminary velocity as needed in fpm.
e. Final air flow rate in cfm.
f. Final velocity in fpm.

g. Space temperature in deg F.

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.
b. Entering-water temperature in deg F.
c. Leaving-water temperature in deg F.
d. Water pressure drop in feet of head or psig.
e. Entering-air temperature in deg F.
f. Leaving-air temperature in deg F.

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.
g. Water pressure differential in feet of head or psig.
h. Required net positive suction head in feet of head or psig.
i. Pump rpm.
j. Impeller diameter in inches.
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.
b. Pump shutoff pressure in feet of head or psig.
c. Actual impeller size in inches.
d. Full-open flow rate in gpm.
e. Full-open pressure in feet of head or psig.
f. Final discharge pressure in feet of head or psig.
g. Final suction pressure in feet of head or psig.
h. Final total pressure in feet of head or psig.
i. Final water flow rate in gpm.
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.

3.17 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 Engineer.
2. The TAB contractor's test and balance engineer shall conduct the inspection in the presence of Construction Manager.
3. Design Engineer 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.

3.18 ADDITIONAL TESTS

A. Within 90 days of completing TAB, perform additional TAB to verify that balanced conditions are being maintained throughout and to correct unusual conditions.

B. Seasonal Periods: If initial TAB procedures were not performed during near-peak summer and winter conditions, perform additional TAB during near-peak summer and winter conditions.

END OF SECTION 23 05 93

SECTION 23 07 13 - DUCT INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. Perform all work required to provide and install ductwork insulation and jackets indicated by the contract documents with supplementary items necessary for proper installation.

B. Section includes insulating the following duct services:

1. Indoor, concealed and exposed supply and outdoor air.
2. Indoor, concealed and exposed return located in unconditioned space.
3. Indoor, concealed and exposed, Type I, commercial, kitchen hood exhaust.
4. Indoor, concealed and exposed exhaust between isolation damper and penetration of building exterior.
5. Outdoor, concealed and exposed supply and return.

1.2 SUBMITTALS

A. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory- and field-applied if any).

B. Qualification Data: For qualified Installer.

1.3 QUALITY ASSURANCE

A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.

B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84, by a testing 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 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.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.5 COORDINATION

A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment."

B. Coordinate clearance requirements with duct Installer for duct insulation application. Before preparing ductwork Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

C. Coordinate installation and testing of heat tracing.

1.6 SCHEDULING

A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.

B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

A. All material shall meet or exceed all applicable referenced standards, federal, state, and local requirements, and conform to codes and ordinances of authorities having jurisdiction.

B. Comply with requirements in "Duct Insulation Schedule, General," "Indoor Duct and Plenum Insulation Schedule," and "Aboveground, Outdoor Duct and Plenum Insulation Schedule" articles for where insulating materials shall be applied.

C. Products shall not contain asbestos, lead, mercury, or mercury compounds.

D. 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.

E. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.

F. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

G. Fiber Blanket Insulation: Glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, Type III with factory-applied FSK jacket.

1. Products: Subject to compliance with requirements, provide one of the following:

a. CertainTeed Corp.; SoftTouch Duct Wrap.
b. Johns Manville; Microlite.
c. Knauf Insulation; Friendly Feel Duct Wrap.
d. Owens Corning; SOFTR All-Service Duct Wrap.

2.2 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.

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B. Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-127.
b. Eagle Bridges - Marathon Industries; 225.
c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-60/85-70.
d. 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).

2.3 MASTICS

A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.

B. Vapor-Barrier Mastic: Water based; suitable for indoor use on below ambient services.

1. Products: Subject to compliance with requirements, provide the following:

a. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-80/30-90.
b. Vimasco Corporation; 749.

2. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.013 perm at 43-mil dry film thickness.
3. Service Temperature Range: Minus 20 to plus 180 deg F.
4. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.

C. Breather Mastic: Water based; suitable for indoor and outdoor use on above ambient services.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-10.
b. Eagle Bridges - Marathon Industries; 550.
c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 46-50.
d. Mon-Eco Industries, Inc.; 55-50.
e. Vimasco Corporation; WC-1/WC-5.

2. Water-Vapor Permeance: ASTM F 1249, 1.8 perms at 0.0625-inch dry film thickness.
3. Service Temperature Range: Minus 20 to plus 180 deg F.
4. Solids Content: 60 percent by volume and 66 percent by weight.

2.4 SEALANTS

A. FSK and Metal Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, provide one of the following:

a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.
b. Eagle Bridges - Marathon Industries; 405.
c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 95-44.
d. Mon-Eco Industries, Inc.; 44-05.

2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F.
5. Color: Aluminum.
6. For indoor applications, use sealants that have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.5 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. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.

2.6 FIELD-APPLIED JACKETS

A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.

B. Metal Jacket:

1. Products: Subject to compliance with requirements, provide one of the following:

a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Metal Jacketing Systems.
b. ITW Insulation Systems; Aluminum and Stainless Steel Jacketing.
c. RPR Products, Inc.; Insul-Mate.

2. Aluminum Jacket: Comply with ASTM B 209, Alloy 3003, 3005, 3105, or 5005, Temper H-14.

a. Finish and thickness are indicated in field-applied jacket schedules.
b. Moisture Barrier for Indoor Applications: 3-mil-thick, heat-bonded polyethylene and kraft paper.
c. Moisture Barrier for Outdoor Applications: 3-mil-thick, heat-bonded polyethylene and kraft paper.

C. Self-Adhesive Outdoor Jacket: 60-mil-thick, laminated vapor barrier and waterproofing membrane for installation over insulation located aboveground outdoors; consisting of a rubberized bituminous resin on a crosslaminated polyethylene film covered with white aluminum-foil facing.

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. Polyguard Products, Inc.; Alumaguard 60.

2.7 TAPES

A. 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, provide one of the following:

a. ABI, Ideal Tape Division; 491 AWF FSK.
b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0827.
c. Compac Corporation; 110 and 111.
d. Venture Tape; 1525 CW NT, 1528 CW, and 1528 CW/SQ.

2. Width: 3 inches.
3. Thickness: 6.5 mils.
4. Adhesion: 90 ounces force/inch in width.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch in width.
7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

B. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.

1. Products: Subject to compliance with requirements, provide one of the following:

a. ABI, Ideal Tape Division; 488 AWF.
b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0800.
c. Compac Corporation; 120.
d. Venture Tape; 3520 CW.

2. Width: 2 inches.
3. Thickness: 3.7 mils.
4. Adhesion: 100 ounces force/inch in width.
5. Elongation: 5 percent.
6. Tensile Strength: 34 lbf/inch in width.

2.8 SECUREMENTS

A. Bands:

1. Products: Subject to compliance with requirements, provide one of the following:

a. ITW Insulation Systems; Gerrard Strapping and Seals.
b. RPR Products, Inc.; Insul-Mate Strapping, Seals, and Springs.

2. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 304; 0.015 inch thick, 1/2 inch wide with wing seal or closed seal.
3. Aluminum: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 1/2 inch wide with wing seal or closed seal.

4. Springs: Twin spring set constructed of stainless steel with ends flat and slotted to accept metal bands. Spring size determined by manufacturer for application.

B. Insulation Pins and Hangers:

1. Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.135-inch-diameter shank, length to suit depth of insulation indicated.

   a. Products: Subject to compliance with requirements, provide one of the following:

      1) AGM Industries, Inc.; CWP-1.
      2) GEMCO; CD.
      3) Midwest Fasteners, Inc.; CD.
      4) Nelson Stud Welding; TPA, TPC, and TPS.

2. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch-diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.

   a. Products: Subject to compliance with requirements, provide one of the following:

      1) AGM Industries, Inc.; CHP-1.
      2) GEMCO; Cupped Head Weld Pin.
      3) Midwest Fasteners, Inc.; Cupped Head.
      4) Nelson Stud Welding; CHP.

3. 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, provide one of the following:

      1) AGM Industries, Inc.; Tactoo Perforated Base Insul-Hangers.
      2) GEMCO; Perforated Base.
      3) Midwest Fasteners, Inc.; Spindle.

   b. Baseplate: Perforated, galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
   c. Spindle: Copper- or zinc-coated, low-carbon steel, fully annealed, 0.106-inch-diameter shank, length to suit depth of insulation indicated.
   d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.

4. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick, galvanized-steel sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.

a. Products: Subject to compliance with requirements, provide one of 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.

C. Staples: Outward-clinching insulation staples, nominal 3/4-inch-wide, stainless steel or Monel.

D. Wire: 0.062-inch 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.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.

1. Verify that systems to be insulated have been tested and are free of defects.
2. Verify that surfaces to be insulated are clean and dry.

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

3.2 PREPARATION

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

3.3 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of ducts and fittings.

B. Install insulation materials, vapor barriers or retarders, jackets, and thicknesses required for each item of duct 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. Keep insulation materials dry during application and finishing.

G. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

H. Install insulation with least number of joints practical.

I. 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.

J. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

K. Install insulation with factory-applied jackets as follows:

1. Draw jacket tight and smooth.
2. Cover circumferential joints with 3-inch-wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
3. Overlap jacket longitudinal seams at least 1-1/2 inches. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches o.c.

   a. For below ambient services, apply vapor-barrier mastic over staples.

4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct flanges and fittings.

L. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

M. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

N. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

O. Provide external insulation to all supply ceiling diffusers connectors and on top of diffusers.

3.4 PENETRATIONS

A. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.

1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
4. Seal jacket to wall flashing with flashing sealant.

B. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

3.5 INSTALLATION OF FIBER INSULATION

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 and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
   b. On duct sides with dimensions larger than 18 inches, place pins 16 inches o.c. each way, and 3 inches 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 from one edge and one end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch 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 at 18-foot 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 two times the insulation thickness, but not less than 3 inches.

5. Overlap unfaced blankets a minimum of 2 inches on longitudinal seams and end joints. At end joints, secure with steel bands spaced a maximum of 18 inches 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-wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.

3.6 FINISHES

A. Do not field paint aluminum or stainless-steel jackets.

3.7 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:

1. Inspect ductwork, randomly selected by Architect and Engineers, 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 duct system defined in the "Duct Insulation Schedule, General" Article.

C. All insulation applications will be considered defective Work if sample inspection reveals non-compliance with requirements.

3.8 DUCT INSULATION SCHEDULE, GENERAL

A. Plenums and Ducts Requiring Insulation:

1. Indoor, concealed and exposed supply and outdoor air.
2. Return air duct located in unconditioned space.
3. Indoor, concealed and exposed Type I, commercial, kitchen hood exhaust.
4. Indoor, concealed and exposed oven and warewash exhaust.
5. Indoor, concealed and exposed exhaust between isolation damper and penetration of building exterior.
6. Outdoor, concealed and exposed supply and return.

B. Items Not Insulated:

1. Return-air duct in conditioned areas (plenums).
2. Exhaust-air ductwork.
3. Fume hood exhaust ductwork.
4. Fibrous-glass ducts.
5. Metal ducts with duct liner of sufficient thickness to comply with energy code and ASHRAE/IESNA 90.1.
6. Factory-insulated flexible ducts.
7. Factory-insulated plenums and casings.

8. Flexible connectors.
9. Vibration-control devices.
10. Factory-insulated access panels and doors.

3.9 INDOOR DUCT AND PLENUM INSULATION SCHEDULE

A. Concealed or exposed, rectangular, round and flat-oval, supply-air, and outside-air duct inside mechanical rooms insulation shall be the following:

1. Mineral-Fiber Board: 1-1/2” inches thick and 3.0-lb/cu. ft. nominal density.

B. Concealed or exposed, Type I, Commercial, Kitchen Hood Exhaust Duct and Plenum Insulation: Fire-rated blanket; thickness as required to achieve 2-hour fire rating.

3.10 OUTDOOR DUCT AND PLENUM INSULATION SCHEDULE

A. Concealed or exposed, rectangular, round and flat-oval, supply-air, return-air and outside-air duct insulation shall be the following:

1. Mineral-Fiber Board: 1-1/2” inches thick and 3.0-lb/cu. ft. nominal density.

B. Concealed or exposed, Type I, Commercial, Kitchen Hood Exhaust Duct and Plenum Insulation: Fire-rated blanket; thickness as required to achieve 2-hour fire rating.

3.11 INDOOR, FIELD-APPLIED JACKET SCHEDULE

A. Not required.

3.12 OUTDOOR, FIELD-APPLIED JACKET SCHEDULE

A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

B. Ducts and Plenums, Concealed/exposed:

1. Aluminum, Corrugated: 0.020 inch thick.

END OF SECTION 23 07 13

SECTION 23 07 19 - HVAC PIPING INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes insulating the following HVAC piping systems:

1. Condensate drain piping, indoors and outdoors.
2. Refrigerant suction and hot-gas piping, indoors and outdoors.

B. Related Sections:

1. Division 23 Section "HVAC Equipment Insulation."
2. Division 23 Section "Duct Insulation."
3. Division 23 Section "Underground Hydronic Piping" 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.

1.2 SUBMITTALS

A. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory and field applied if any).

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

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.
6. Detail application of field-applied jackets.
7. Detail application at linkages of control devices.

C. Samples: For each type of insulation and jacket indicated. Identify each Sample, describing product and intended use.

1. Preformed Pipe Insulation Materials: 12 inches long by NPS 2.
2. Manufacturer's Color Charts: For products where color is specified, show the full range of colors available for each type of finish material.

D. Qualification Data: For qualified Installer.

E. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.

F. Field quality-control reports.

1.3 QUALITY ASSURANCE

A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.

B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to 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 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.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.5 COORDINATION

A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment."

B. Coordinate clearance requirements with piping Installer for piping insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

C. Coordinate installation and testing of heat tracing.

1.6 SCHEDULING

A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.

B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

A. Comply with requirements in "Piping Insulation Schedule, General," "Indoor Piping Insulation Schedule," "Outdoor, Aboveground Piping Insulation Schedule," and "Outdoor, Underground Piping Insulation Schedule" articles for where insulating materials shall be applied.

B. Products shall not contain asbestos, lead, mercury, or mercury compounds.

C. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

D. Flexible Elastomeric Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Aeroflex USA, Inc.; Aerocel.
b. Armacell LLC; AP Armaflex
c. Rubatex.

2.2 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. Flexible Elastomeric Adhesive: Comply with MIL-A-24179A, Type II, Class I.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Aeroflex USA, Inc.; Aeroseal.
b. Armacell LLC; Armaflex 520 Adhesive.
c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-75.
d. K-Flex USA; R-373 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).

C. 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, provide one of the following:

a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-82.
b. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-50.

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).

2.3 SEALANTS

2.4 SECUREMENTS

A. Bands:

1. Products: Subject to compliance with requirements, provide one of the following:

   a. ITW Insulation Systems; Gerrard Strapping and Seals.
   b. RPR Products, Inc.; Insul-Mate Strapping, Seals, and Springs.

2. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 304 or Type 316; 0.015 inch thick, 3/4 inch wide with wing seal or closed seal.
3. Aluminum: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 3/4 inch wide with wing seal or closed seal.
4. Springs: Twin spring set constructed of stainless steel with ends flat and slotted to accept metal bands. Spring size determined by manufacturer for application.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.

1. Verify that systems to be insulated have been tested and are free of defects.
2. Verify that surfaces to be insulated are clean and dry.
3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

B. Surface Preparation: Clean and prepare surfaces to be insulated. Before insulating, apply a corrosion coating to insulated surfaces as follows:

C. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.

3.3 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping including fittings, valves, and specialties.

B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of 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-wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches o.c.

   a. For below-ambient services, apply vapor-barrier mastic over staples.

4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.

M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

P. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.

1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
4. Seal jacket to wall flashing with flashing sealant.

Q. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

3.4 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. 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.

3.5 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

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.

3.6 FINISHES

A. Pipe Insulation with ASJ, Glass-Cloth, 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.

3.7 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:

1. 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. 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 non-compliance with requirements.

3.8 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.

3.9 INDOOR PIPING INSULATION SCHEDULE

A. Condensate and Equipment Drain Water below 60 Deg F:

1. All Pipe Sizes: Insulation shall be one of the following:
   a. Flexible Elastomeric: 3/4 inch thick.

B. Condenser-Water Supply and Return:

1. No insulation required and Smaller: Insulation shall be one of the following:

   a. Flexible Elastomeric: 1 inch thick.

3.10 OUTDOOR, ABOVEGROUND PIPING INSULATION SCHEDULE

A. Condenser-Water Supply and Return:

1. Condenser water pipe and spray water pipe for fluid cooler.

END OF SECTION 23 07 19

SECTION 23 09 00- INSTRUMENTATION AND CONTROL FOR HVAC

PART 1 - GENERAL

1.1 CODES AND STANDARDS

A. Work, materials, and equipment shall comply with the most restrictive of local, state, and federal authorities' codes and ordinances or these plans and specifications. As a minimum, the installation shall comply with current editions in effect 30 days prior to receipt of bids of the following codes:

1. National Electric Code (NEC)
2. International Building Code (IBC)

    a. Section 608, Shutoff for Smoke Control
    b. Section 403.3, Smoke Detection Group B, Office Buildings and Group R, Division 1 Occupancies
    c. Section 710.5, Wiring in Plenums
    d. Section 71 3. 10, Smoke Dampers
    e. Section 1106, Refrigeration Machinery Rooms
    f. Section 1107, Refrigeration Machinery Room Ventilation
    g. Section 1108, Refrigeration Machinery Room Equipment and Controls
    h. Section 1120, Detection and Alarm Systems

3. Uniform Mechanical Code (UMC)
4. ANSI/ASHRAE Standard 135- 2004, or ANSI/ASHRAE 135-2008, BACnet—A Data Communication Protocol for Building Automation and Control Networks
5. Building Code

1.2 SUBMITTALS

A. Product Submittal Requirements. Meet requirements of Section 01330 on Shop Drawings, Product Data, and Samples. Provide six copies of shop drawings and other submittals on hardware, software, and equipment to be installed or furnished. Begin no work until submittals have been approved for conformity with design intent. Provide drawings as AutoCAD compatible files in electronic format (file format: .dwg, .dxf, .vsd, or comparable) or hard copies on 11 x 17 prints of each drawing. When manufacturer's cutsheets apply to a product series rather than a specific product, clearly indicate applicable data by highlighting or by other means. Clearly reference covered specification and drawing on each submittal. General catalogs shall not be accepted as cut sheets to fulfill submittal requirements. Select and show submittal quantities appropriate to scope of work.

B. Provide submittals within 12 weeks of contract award.

C. Submittal data shall consist of the following:

1. Contractor shall submit documentation in the following phased delivery schedule:

    a. Valve and damper schedules
    b. System schematics, including:

        1) Product Specification Sheets

c. As-built drawings

1.3 WARRANTY

A. Warrant labor and materials for specified control system free from defects for a period of 12 months after final acceptance. Failures on control systems that include all computer equipment, transmission equipment and all sensors and control devices during warranty period shall be adjusted, repaired, or replaced at no additional cost or reduction in service to Owner. Respond during normal business hours within 24 hours of Owner's warranty service request.

PART 2 - PRODUCTS

2.1 MATERIALS:

A. All products used in this project installation shall be new and currently manufactured and shall have been applied in similar installations. Do not use this installation as a product test site unless explicitly approved in writing by Owner or Owner's representative. Spare parts shall be available for at least five years after completion of this contract.

2.2 APPLICATION SPECIFIC CONTROLLERS (ASC)

A. General:

1. Provide for control of each piece of equipment , including, but not limited to the following:
2. Each ASC shall operate as a stand-alone controller capable of performing its specified control responsibilities independently of other controllers in the network. Each ASC shall provide standard applications and programmability to provide both reliability and flexibility. Each ASC shall be a microprocessor-based, multi-tasking, real-time digital control processor.
3. Each ASC shall include all point inputs and outputs necessary to perform the specified control sequences. The ASC shall accept input and provide output signals that comply with industry standards. Controllers utilizing proprietary control output signals shall not be acceptable. Outputs utilized either for two-state, modulating floating, or proportional control, allowing for additional system flexibility.
4. Space Temperature Sensors. Each controller performing space temperature control shall be provided with a matching room temperature sensor.

a. Wired temperature sensor specifications. The sensing element for the space temperature sensor must be IC-based and provide the following.

1) Digitally communicating with the Application Specific Controller.
2) Mountable to and fully covering a 2 x 4 electrical junction box without the need for an adapter wall plate.
3) IC Element Accuracy: +/- 0.9°F
4) Operating Range: 55 to 95°F
5) Set point Adjustment Range: User limiting, selectable range between 55 and 95°F
6) Display of temperature setpoint with numerical temperature values
7) Calibration: Single point, field adjustable at the space sensor to +/- 5°F

8) Installation: Up to 100 ft. from controller
9) Auxiliary Communications Port: included
10) Local OLED Temperature Display: included
11) Display of Temperature to one decimal place
12) Temperature Setpoint Adjustment included
13) Occupancy Override Function included

b. Setpoint Modes:

1) Independent Heating, Cooling
2) Night Setback-Heating
3) Night Setback-Cooling

c. Auxiliary Communication Port. Each room temperature sensor shall include a terminal jack integral to the sensor assembly. The terminal jack shall be used to connect a portable operator's terminal to control and monitor all hardware and software points associated with the controller. RS-232 communications port shall allow the operator to query and modify operating parameters of the local room terminal unit from the portable operator’s terminal.
d. Setpoint Adjustment Dial. The setpoint adjustment function shall allow for modification of the temperature by the building operators. Setpoint adjustment may be locked out, overridden, or limited as to time or temperature through software by an authorized operator at any central workstation, Building Controller, room sensor two-line display, or via the portable operator's terminal.
e. Override Switch. An override button shall initiate override of the night setback mode to normal (day) operation when activated by the occupant and enabled by building operators. The override shall be limited to two (2) hours (adjustable.) The override function may be locked out, overridden, or limited through software by an authorized operator at the operator interface, Building Controller, room sensor two-line display or via the portable operator's terminal.

5. Space Combination Carbon Dioxide (CO2)/Temperature or Carbon Dioxide/Temperature/Relative Humidity Sensors. Each controller performing space temperature, relative humidity or CO2 control shall be provided with a single room sensor, which includes the ability to measure CO2 and temperature or CO2, temperature and relative humidity for either monitoring or control purposes. The combination sensors shall have the same appearance as the space temperature sensors. Room sensing devices shall be digitally communicating with the zone controller, and multiple sensed values (CO2, RH) should not utilize additional analog inputs on the controller. CO2 elements shall be of the non-dispersive infrared (NDIR) technology type, and shall measure over the range of 0 to 2000 parts per million (PPM), with an accuracy of +/- 50PPM + 2% of reading. Where display is needed, display shall be of the organic light emitting diode (OLED) type. Room sensor shall be capable of showing or hiding any displayed value. Measured values (CO2, humidity and temperature) shall be capable of being field calibrated at a single point, as a one-point bias/offset calibration, without the use of additional calibration software. Humidity elements shall measure relative humidity with a +/- 2% accuracy over the range of 10 to 90% relative humidity. Humidity element shall be an IC (integrated circuit) sensing element. Humidity sensing elements shall be removable and field replaceable if needed.
6. Communication. Each controller shall perform its primary control function independent of other Secondary Network communication, or if Secondary Network communication is interrupted. Reversion to a fail-safe mode of operation during Secondary Network interruption is not acceptable.
7. Control Algorithms. The controller shall receive its real-time data from the Building Controller time clock to ensure Secondary Network continuity. Each controller shall

include algorithms incorporating proportional, integral and derivative (PID) gains for all applications. All PID gains and biases shall be field-adjustable by the user via room sensor LCD or the portable operator's terminal as specified herein. Controllers that incorporate proportional and integral (PI) control algorithms only shall not be acceptable.

8. Control Applications. Operating programs shall be field-selectable for specific applications. In addition, specific applications may be modified to meet the user's exact control strategy requirements, allowing for additional system flexibility. Controllers that require factory changes of all applications are not acceptable.
9. Programmability. Application Specific Controllers shall be programmable, using software provided by the BMS manufacturer. Software shall be field-installable on any standard laptop or Portable Operator's Terminal. Program language shall be text-based and allow up to 200 lines of code for programming. Programming shall allow for changing sequence of operation, commanding and releasing points, additional monitoring, and command priority management within the Application Specific Controller.
10. Calibration. Each controller shall include provisions for manual and automatic calibration of the differential pressure transducer in order to maintain stable control and ensuring against drift over time.

    a. Manual calibration may be accomplished by either commanding the actuator to 0% via the POT or by depressing the room sensor override switch. Calibration of the transducer at the controller location shall not be necessary.
    b. Calibration shall be accomplished by stroking the terminal unit damper actuator to a 0% position so that a 0 cfm air volume reading is sensed. The controller shall automatically accomplish this whenever the system mode switches from occupied to unoccupied or vice versa.
    c. Calibration shall be accomplished by zeroing out the pressure sensor and holding damper at last known position until calibration is complete. The controller shall automatically accomplish this whenever the system mode switches from occupied to unoccupied or vice versa.

11. Memory.

    a. Provide each ASC with sufficient memory to accommodate point databases, operating programs, programming capability, local alarming and local trending. All databases and programs shall be stored in non-volatile EEPROM, EPROM and PROM, or minimum of 72-hour battery backup shall be provided. The controllers shall be able to return to full normal operation without user intervention after a power failure of unlimited duration.
    b. Upon replacement, new ASCs shall recover control function and site specific defaults automatically and resume normal operation.

12. Power Supply. The ASCs shall be powered from a 24 Vac source and shall function normally under an operating range of 18 to 28 Vac, allowing for power source fluctuations and voltage drops. Power supply for the ASC must be rated at a minimum of 125% of ASC power consumption and shall be of the fused or current limiting type. The BMS contractor shall provide 24 Vac power to the terminal units by utilizing:

    a. The existing line voltage power trunk and installing separate isolation transformers for each controller.
    b. Dedicated line voltage power source and isolation transformers at a central location and installing 24 Vac power trunk to supply multiple ASCs in the area.

13. Environment. The controllers shall function normally under ambient conditions of 32 to 122°F (0 to 50°C) and 10% to 95% rh (non-condensing). Provide each controller with a suitable cover or enclosure to protect the circuit board assembly.

14. Immunity to noise. Operation shall be protected against electrical noise of 5-120 Hz and from keyed radios up to 5 W at 1 m (3 ft).
15. Manufacturer Installed Controls.

    a. BMS manufacturer shall furnish ASC and actuator for factory mounting to equipment manufacturer.
    b. Cost of factory mounting shall be borne by equipment manufacturer.
    c. For VAV terminals, equipment manufacturer shall provide and install flow-cross sensor, 24 Vac transformer, controls enclosure, fan relay, SCR and factory install, wire and tube ASC controller and actuator.
    d. Fan powered VAV terminals shall be equipped with a fan speed controller and relay to change summer and winter speed setpoint.

2.3 INPUT/OUTPUT INTERFACE:

A. Hardwired inputs and outputs may tie into the system through building or application specific controllers.

B. Modular, “hot-swappable” I/O so that the electronics of a small portion of the I/O can be replaced without effecting the power or communication for the other points.

C. All input points and output points shall be protected such that shorting of the point to itself, to another point, or to 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.

D. 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 and shall be protected against the effects of contact bounce and noise. Binary inputs shall sense “dry contact” closure without external power (other than that provided by the controller) being applied.

E. Pulse accumulation input objects. This type of object shall conform to all the requirements of binary input objects and also accept up to 10 pulses per second for pulse accumulation.

F. Analog inputs shall allow the monitoring of low-voltage (0 to 10 Vdc), current (4 to 20 mA), or resistance signals (thermistor, RTD). Analog inputs shall be compatible with—and field configurable to—commonly available sensing devices.

G. 24 Vdc shall be available next to the point signal for powering the output device.

H. Binary outputs shall provide for On/Off operation or a pulsed low-voltage signal for pulse width modulation control. Binary outputs on building and custom application controllers shall have three-position (On/Off/Auto) override switches and status lights. Outputs shall be selectable for either normally open or normally closed operation.

I. Analog outputs shall provide a modulating signal for the control of end devices. Outputs shall provide either a 0 to 10 Vdc, or 4 to 20 mA signal as required to provide proper control of the output device. Analog outputs on building or custom application controllers shall have status lights and manual override. Analog outputs shall not exhibit a drift of greater than 0.4% of range per year.

J. Tri-State Outputs. Provide tri-state outputs (two coordinated binary outputs) for control of three-point floating type electronic actuators without feedback. Use of three-point floating devices

shall be limited to zone control and terminal unit control applications (VAV terminal units, duct-mounted heating coils, zone dampers, radiation, etc.). Control algorithms shall run the zone actuator to one end of its stroke once every 24 hours for verification of operator tracking.

K. Point name labels. It shall be possible to print customized name labels for each I/O point and install on an existing holder on the I/O device.

L. System Object Capacity. The system size shall be expandable to at least twice the number of input/ output objects required for this project. Additional controllers (along with associated devices and wiring) shall be all that is necessary to achieve this capacity requirement. The operator interfaces installed for this project shall not require any hardware additions or software revisions in order to expand the system.

2.4 POWER SUPPLIES AND LINE FILTERING

A. Control transformers shall be UL listed. Furnish Class 2 current-limiting type or furnish over-current protection in both primary and secondary circuits for Class 2 service in accordance with NEC requirements. Limit connected loads to 80% of rated capacity.

B. DC power supply output shall match output current and voltage requirements. Unit shall be full-wave rectifier type with output ripple of 5.0 mV maximum peak-to-peak. Regulation shall be 1.0% line and load combined, with 100-microsecond response time for 50% load changes. Unit shall have built-in over-voltage and over-current protection and shall be able to withstand a 150% current overload for at least three seconds without trip-out or failure.

1. Unit shall operate between 0°C and 50°C (32°F and 120°F). EM/RF shall meet FCC Class B and VDE 0871 for Class B and MILSTD 810C for shock and vibration.
2. Line voltage units shall be UL recognized and CSA approved.

C. Power line filtering.

1. Provide transient voltage and surge suppression for all workstations and controllers either internally or as an external component. Surge protection shall have the following at a minimum:

   a. Dielectric strength of 1000 volts minimum,
   b. Response time of 10 nanoseconds or less,
   c. Transverse mode noise attenuation of 65 dB or greater,
   d. Common mode noise attenuation of 150 dB or better at 40 Hz to 100 Hz.

2.5 AUXILIARY CONTROL DEVICES

A. GENERAL

1. Specified in this section are the following hard wired input/output devices connected to the Building Controller or ASC.
   a. Airflow Measuring Stations
   b. Binary Temperature Devices
   c. Temperature Sensors
   d. Analog Water Level Sensors
   e. Audio/Visual Alarm Units
   f. Water BTU Meters
   g. Vortex Shedding Flow Meters

h.
i. Indoor Air Quality (CO2/VOC/TEMP/RH) Space Sensors

B. AUTOMATIC DAMPERS

1. Dampers shall have 13 gauge galvanized frames of not less than 3 inches wide and blades of 14 gauge, equivalent thickness, galvanized steel roll formed airfoil type for low pressure drop and low noise generation and shall be adequately braced to from a rigid assembly where required in galvanized duct work. Dampers shall have blades not more than 8 inches wide. Linkage and hardware shall be zinc plated steel and shall be concealed out of airstream within the damper frame. Damper blades and rods shall be installed in horizontal position.
2. In copper, aluminum and stainless steel ductwork, damper material shall match the ductwork material.
3. All dampers shall be of the proportioning or opposed blade type, and shall be motor operated. Dampers shall have continuous elastomer or stainless steel stops to avoid leakage. Bearings shall be corrosion resistant oil tight stainless steel sleeve type. All dampers shall be provided with continuous 3/16" x 1/2" closed cell neoprene gasket around perimeter of the frame and at interlocking blade edges to form an air tight seal. Blade seals shall be suitable for -76□F to 350□F mechanically locked into blade edge. Adhesive of clip on type are not acceptable. Axles shall be square or hexagonal positively locked into damper blade. Linkage shall be concealed out of airstream within the damper blade.
4. All dampers shall be constructed to provide a maximum leakage of 3-1/2%, with an approach velocity of 1500 fpm when closed against a pressure of 4 inches of water. Submit leakage and flow characteristic data for all dampers.
5. All outside air dampers, with the exception of the emergency generator dampers, shall automatically close in the event of a loss of power. Dampers on emergency generators shall automatically open on a loss of power.
6. All smoke dampers shall be constructed in accordance with UL Standard 555S.
7. Dampers shall be Greenheck, Imperial Model 800 or approved equal.

C. FIRE/SMOKE DAMPERS

1. Dampers shown on drawings designated as “F/SM” shall comply with the following. They shall have a U.L. label. Dampers shall be electronically operated combination fire and smoke Greenheck Imperial or approved equal, provided with factory installed U.L. rated full sleeves. Provide air foil or “V” blade damper blades supported with shafts and stainless steel bearings to allow daily operation. Provide intermediate supports and bearings for damper blades more than 36” long. They shall conform to UL Standard 555 and 555S as leakage rated dampers in smoke control systems when closed shall be the equivalent of a 1-1/2 hour fire damper. Leakage shall conform to Class 2 with maximum leakage of 10 cfm/Sq. Ft. at 1” W.G. Damper actuators shall be provided with position indicator switches to enable remote status of open or closed positions (only those dampers designated in the electrical trade plans and specifications will be provided with position switches and will be wired for remote status and remote open/closed operation, but all dampers will be provided with position indicators for possible future use). Note that dampers which are controlled from a central fire command station shall be provided with a 212□F heat sensor with normally closed contacts (manual reset) to close and lock damper if open. Additionally, dampers shall be factory equipped with a second normally closed heat sensor correlating to the operator/actuator degradation temperature classification (250□F to 350□F, depending on the actuator utilized). The second sensor is wired through a manual override switch on the central fire command station. Dampers which are not controlled from a central fire command station shall have a fusible link which melts on heat causing damper to close and lock in a closed position. The following will be accepted in lieu of the two firestats described. A resettable bimetallic link which

opens on heat permitting damper to close and lock if open. This link may be re-engaged from fire command station at temperature of 150□F or less.

2. Dampers shown on drawings designated “SM” shall comply in all respects to F/S damper description including position indicating switches except they shall not be provided with a heat sensor or fusible link.

D. Electric Damper Actuators

1. General

a. All damper actuators having more then 100 lb-in torque output shall have a self-centering damper shaft clamp. V-bolt type damper shaft clamp is not acceptable.
b. The actuator shall have mechanical or electronic stall protection to prevent damage to the actuator throughout the rotation of the actuator.
c. Where shown, for power-failure/safety applications, an internal mechanical, spring-return mechanism shall be built into the actuator housing. Alternatively, an uninterruptible power supply (UPS) may be provided. On terminal unit valves actuators and 2-second timing damper actuators capacitor driven fail action is permitted.
d. Modulating actuator shall accept a 0-10 Vdc control signal and provide a 0-10 Vdc operating range
e. All 24 Vac/Vdc actuators shall operate on Class 2 wiring.
f. All actuators over 20 lb-in torque capacity shall have an external manual gear release to allow manual positioning of the damper when the actuator is not powered and spring-return actuators shall have a manual crank for this purpose.
g. Upon start up and after power loss, the actuator must immediately respond to control signals. Actuators requiring calibration to determine end stops are not acceptable.
h. Electric actuators for emergency generator damper control shall be rated for 350°F maximum operating temperature and capable to drive fully open and close within 15 seconds.
i. All actuators that provide a factory mounted electrical appliance or plenum rated cabling must be marked with numbers on the wires as well as color coded.
j. Provide built-in dual end switches as required for the sequence of operation.
k. Control damper actuators shall be RoHS Part A complaint.

E. AIRFLOW MEASURING STATIONS

1. Fan Inlet Type:

a. Provide where indicated on the plans, airflow measuring stations of fan inlet type. Airflow traverse probes shall be suitable for mounting in the inlet bell(s) of the indicated fan.
b. Probes shall be provided with the appropriate end support brackets for mounting in the inlet bell(s). Where fans are of dual inlet type, two sets of inlet probes must be provided.
c. Fan inlet probes shall be provided with the fittings to allow for the connection of control tubing to the probe assemblies.
d. Probes shall be capable of operating with an accuracy of 3% of actual volume over the fan operating range.
e. The installation of the airflow measuring stations shall be coordinated with sheet metal contractor to ensure actual accuracy and accessibility for maintenance.
f. The installation of the airflow measuring stations shall be coordinated with sheet metal contractor to ensure actual accuracy and accessibility for maintenance.
g. Fan inlet probes shall be Tek-Air T-FP7000.

2. Duct Mounted Type:

   a. Provide where indicated on the plans, airflow traverse probes of the insertion type, capable of continuously measuring air volume in the duct served.
   b. Probes shall utilize multiple total and suction pressure measurement points, located along the length of the probe surface in accordance with ASHRAE recommendations for duct traversing.
   c. The probes shall provide measurement accuracy within ± 2% of actual velocity when used with the appropriate conversion formula.
   d. Probes shall be of cylindrical cross section and shall indicate no more than a ± 3% percent deviation from the centerline velocity at a yaw angles up to 30 degrees.
   e. Probes shall be constructed of extruded aluminum, unless dictated otherwise by service requirements. Probes over sixteen inches long shall be supported on the insertion end.
   f. Probe quantities for each location shall be sufficient to meet ASHRAE recommendations.
   g. The pressure drop created by the traverse probes shall not be greater ten percent of the velocity pressure at the maximum design flow.
   h. The probes shall not amplify sound levels in the duct. The manufacturer shall provide submittal data indicating the developed differential pressure and pressure loss at the minimum and maximum design air flows for each duct location.
   i. Traverse probes shall be Tek-Air model T-FP5000.

F. BINARY TEMPERATURE DEVICES

G. TEMPERATURE SENSORS.

1. Provide the following instrumentation as required by the monitoring, control and optimization functions. All temperature sensors shall use platinum RTD elements only, nickel or silicon are not acceptable. All control signals shall be via a 4-20 mA loop.
2. Room Temperature:

a.	Temperature monitoring range	+40/+90°F (+40/120°F for high temp alarms)
b.	Output signal	4-20 mA
c.	Installation adjustments	none required
d.	Calibration adjustments	none required
e.	Factory calibration point	32°F
f.	Accuracy at calibration point	+/- 0.7°F

3. Duct (Single Point) Temperature

a.	Temperature monitoring range	+20/+120°F or +30/+250°F
b.	Output signal	4-20 mA
c.	Installation adjustments	none required
d.	Calibration adjustments	none required
e.	Factory calibration point	70°F
f.	Accuracy at calibration point	+/- 0.54°F

4. Outside Air Temperature

a.	Temperature monitoring range	-58/+122°F
b.	Output signal	4-20 mA
c.	Installation adjustments	none required

d. Calibration adjustments none required
e. Factory calibration point 32°F
f. Accuracy at calibration point +/- 0.54°F

H. DEW POINT/HUMIDITY SENSORS

1. Outside Air Dew Point Temperature

a. Dew point monitoring range -40/+115°F DP, 12% to 99% rh
b. Output signal 4-20 mA
c. Calibration adjustments none required
d. Factory calibration point 70°F
e. Accuracy at calibration point +2.0°F DP

2. Room/duct Relative Humidity

a. Sensor Humidity range 0 to 100%
b. Operating temperature 15°F to +170°F
c. Accuracy +2% rh
d. Sensing element Capacitive sensor
e. Output signal 4-20 mA DC
f. Installation adjustments none required
g. Operating temperature 15°F to +170°F
h. Voltage requirement 12-36 Vdc

I. PRESSURE SENSORS

1. Air Static Pressure Sensor

a. Duct Static range -.5 to + 7.5" wg
b. Accuracy + .05" wg
c. Output signal 4 - 20 mA

J. DIFFERENTIAL PRESSURE SWITCHES.

1. Water Differential Pressure Switch

a. Differential pressure type switches (air or water service) shall be UL listed, SPDT snap-acting, pilot duty rated (125 VA minimum), NEMA 1 enclosure, with scale range and differential suitable for intended application or as shown.
b. The differential switches shall meet the following requirements:

1) Range 8 to 70 psi
2) Differential 3 psi
3) Maximum differential pressure 200 psi
4) Maximum pressure 325 psi

2. Air Differential Pressure Switch

a. Differential pressure switches shall be diaphragm type, with die-cast aluminum housing and adjustable setpoint. Switch rating shall be a minimum 5 amps at 120 Vac. Switches shall be SPDT and be used for fan status as specified in the point

schedule. Switch pressure range shall be suited for application (e.g., filter 0-2.0", fan status 0-5.0", etc.).

K. INDOOR AIR QUALITY (CO_2/ TEMP/RH) SENSORS

1. Provide indoor air quality sensors to monitor Carbon Dioxide (CO_2) and/or Volatile Organic Compound (VOC) levels, and /or Temperature and Humidity.
2. The CO_2 sensor shall be of microprocessor-based non-dispersive infrared type (NDIR) with an additional integrated reference light source.
3. The CO_2 sensors shall have no more than 1% drift during the first year of operation and minimal drift thereafter so that no calibration will be required.
4. The units shall be wall or duct mounted type as indicated on plans and in the sequence of operation.
5. Wall mounted sensors shall be provided with white plastic cover, without LED indicators.
6. Duct and Wall mounted sensors shall be suitable for zones with 24/7 occupancy
7. Duct and Wall mounted sensors with Temperature shall have an option for active or passive temperature outputs (based on part number)
8. Duct mounted sensors shall be provided without the need for a separate aspirator box.
9. The VOC sensor shall have automatic self calibrating capability to ensure accuracy.
10. The sensor shall meet the following requirements:

a.	Operating voltage:	24 Vac +/- 20%, or 15 to 35Vdc
b.	Frequency:	50/60 Hz
c.	Power consumption:	max. 6 VA
d.	CO_2 measuring range:	0 – 2000 ppm
e.	Tolerance:	+/- 50 ppm
f.	Output:	0 – 10 Vdc or 0 – 5 Vdc Field configurable
g.	Output (passive T, selectable)	pt100, pt1000, Ni1000, NTC 10K
h.	Calibration:	none required
i.	VOC measurement range:	0 – 10V VOC
j.	Permissible air velocity in duct:	<26.2 ft/s.

PART 3 - EXECUTION

3.1 EXAMINATION

A. The project plans shall be thoroughly examined for control device and equipment locations. 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 may be installed as shown. Any discrepancies, conflicts, or omissions shall be reported to the engineer for resolution before rough-in work is started.

C. The contractor shall examine the drawings and specifications for other parts of the work. If head room or space conditions appear inadequate—or if any discrepancies occur between the plans and the contractor’s work and the plans and the work of others—the contractor shall report these discrepancies to the engineer and shall obtain written instructions for any changes necessary to accommodate the contractor’s work with the work of others.

3.2 PROTECTION

A. The contractor shall protect all work and material from damage by its employees and/or subcontractors and shall be liable for all damage thus caused.

B. The contractor shall be responsible for its work and equipment until finally inspected, tested, and accepted.

3.3 COORDINATION

A. Site

1. The project coordination between trades is the responsibility of the prime contractor who is the one tier higher contractual partner such as mechanical contractor, general contractor, construction manager, owner or owner's representative as applicable.
2. The controls contractor shall follow prime contractor's job schedule and coordinate all project related activities through the prime contactor except otherwise agreed or in minor job site issues. Reasonable judgment shall be applied.
3. Where the work will be installed in close proximity to, or will interfere with, work of other trades, the contractor shall assist in working out space conditions to make a satisfactory adjustment.
4. If the contractor deviates form the job schedule and installs work without coordinating with other trades, so as to cause interference with work of other trades, the contractor shall make the necessary changes to correct the condition without extra charge.
5. Coordinate and schedule work with all other work in the same area, or with work that is dependent upon other work, to facilitate mutual progress.

B. Submittals:

1. Refer to the Submittals section in – GENERAL of this specification for requirements.

C. Test and Balance:

1. The contractor shall furnish a single set of all tools necessary to interface to the control system for test and balance purposes.
2. The contractor shall provide training in the use of these tools. This training will be planned for a minimum of 4 hours.
3. In addition, the contractor shall provide a qualified technician for duration of 8 hours to assist in the test and balance process.
4. The tools used during the test and balance process shall be returned at the completion of the testing and balancing.

D. Life Safety:

1. Duct smoke detectors required for air handler shutdown are supplied under Division 16 of this specification. The contractor shall interlock smoke detectors to air handlers for shutdown as described in the Sequences of Operation section in – PRODUCTS of this specification.
2. Smoke dampers and actuators required for duct smoke isolation are provided under a Section of Division 15. The contractor shall interlock these dampers to the air handlers as described in the Sequences of Operation section in – PRODUCTS of this specification
3. Fire/smoke dampers and actuators required for fire rated walls are provided under another Section of Division 23. Control of these dampers shall be by Division 26.

E. Coordination with controls specified in other sections or divisions.

1. Other sections and/or divisions of this specification include controls and control devices that are to be part of or interfaced to the control system specified in this section. These controls shall be integrated into the system and coordinated by the contractor as follows:
2. Communication media and equipment shall be provided as specified in the Communications section in – PRODUCTS of this specification.

    a. Each supplier of controls product is responsible for the configuration, programming, startup, and testing of that product to meet the sequences of operation described in this section.
    b. The Contractor shall coordinate and resolve any incompatibility issues that arise between the control products provided under this section and those provided under other sections or divisions of this specification.
    c. The contractor is responsible for providing all controls described in the contract documents regardless of where within the contract documents these controls are described.
    d. The contractor is responsible for the interface of control products provided by multiple suppliers regardless of where this interface is described within the contract documents.

3.4 GENERAL WORKMANSHIP

A. Install equipment, piping, and wiring/raceway 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 locations as defined by Chapter 1, Article 100, Part A of the National Electrical Code (NEC).

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.

3.5 FIELD QUALITY CONTROL

A. Contractor shall have a six (6) Sigma certified quality manager on staff to inspect the project execution and to enforce quality standards.

B. The Work, materials, and equipment shall comply with the rules and regulations of applicable local, state, and federal codes and ordinances as identified in – GENERAL of this specification.

C. Contractor shall continually monitor the field installation for code compliance and quality of workmanship.

D. Contractor shall have work inspected by local and/or state authorities having jurisdiction over the work.

3.6 WIRING

A. All control and interlock wiring shall comply with national and local electrical codes and Division 16 of this specification. Where the requirements of this section differ from those in Division 16, the requirements of this section shall take precedence.

B. All NEC Class 1 (line voltage) wiring shall be UL Listed in approved conduit according to NEC and Division 16 requirements.

C. All low-voltage wiring shall meet NEC Class 2 requirements. (Low-voltage power circuits shall be sub–fused when required to meet Class 2 current limit.)

D. Where NEC Class 2 (current-limited) wires are in concealed and accessible locations, including ceiling return air plenums, approved cables not in conduit may be used provided that cables are UL Listed for the intended application. For example, cables used in ceiling plenums shall be UL Listed specifically for that purpose.

E. All wiring in mechanical, electrical, or service rooms—or where subject to mechanical damage—shall be installed in conduit.

F. Do not install Class 2 wiring in conduit containing Class 1 wiring. Boxes and panels containing high voltage wiring and equipment may not be used for low-voltage wiring except for the purpose of interfacing the two (e.g., relays and transformers).

G. Do not install wiring in conduit containing tubing.

H. Where plenum rated cable is run exposed, wiring is to be run parallel along a surface or perpendicular to it and neatly tied at 3 m (10 ft) intervals.

I. Where plenum rated cable is used without conduit, it shall be supported from or anchored to structural members. Cables shall not be supported by or anchored to ductwork, electrical conduits, piping, or ceiling suspension systems.

J. All wire-to-device connections shall be made at a terminal block or wire nut. All wire-to-wire connections shall be at a terminal strip or wire nut.

K. All wiring within enclosures shall be neatly bundled and anchored to permit access and prevent restriction to devices and terminals.

L. Maximum allowable voltage for control wiring shall be 120V. If only higher voltages are available, the contractor shall provide step-down transformers or interposing relays.

M. All plenum rated wiring shall be installed as continuous lengths, with no splices permitted between termination points.

N. All wiring in conduit shall be installed as continuous lengths, with no splices permitted between termination points or junction boxes.

O. Maintain fire rating at all penetrations. Install plenum wiring in sleeves where it passes through walls and floors.

P. Size and type of conduit and size and type of wire shall be the responsibility of the contractor, in keeping with the manufacturer’s recommendations and NEC requirements, except as noted elsewhere.

Q. Include one pull string in each conduit 3/4 inches or larger.

R. Control and status relays are to be located in designated enclosures only. These enclosures can include packaged equipment control panel enclosures unless they also contain Class 1 starters.

S. Conceal all conduit, except within mechanical, electrical, or service rooms. Install conduit to maintain a minimum clearance of 15 cm (6 in.) from high-temperature equipment (e.g., steam pipes or flues).

T. Secure conduit with conduit clamps fastened to the structure and spaced according to code requirements. Conduit and pull boxes may not be hung on flexible duct strap or tie rods. Conduits may not be run on or attached to ductwork.

U. Adhere to this specification's Division 16 requirements where conduit crosses building expansion joints.

V. The Contractor shall terminate all control and/or interlock wiring and shall maintain updated (as-built) wiring diagrams with terminations identified at the job site.

W. Flexible metal conduits and liquid-tight, flexible metal conduits shall not exceed 1 m (3 ft) in length and shall be supported at each end. Flexible metal conduit less than 1/2 inches 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.

X. Conduit must be adequately supported, properly reamed at both ends, and left clean and free of obstructions. Conduit sections shall be joined with couplings (according to code). Terminations must be made with fittings at boxes, and ends not terminating in boxes shall have bushings installed.

3.7 INSTALLATION OF SENSORS:

A. General:

1. Install sensors in accordance with the manufacturer's recommendations.
2. Mount sensors rigidly and adequately for the environment within which the sensor operates.
3. Room temperature sensors shall be installed on concealed junction boxes properly supported by the wall framing.
4. All wires attached to sensors shall be air sealed in their raceways or in the wall to stop air transmitted from other areas affecting sensor readings.
5. Sensors used in mixing plenums and hot and cold decks shall be of the averaging type.
6. Low-limit sensors used in mixing plenums shall be installed in a serpentine manner horizontally across the full face of the coil.
7. All pipe-mounted temperature sensors shall be installed in wells. Install all liquid temperature sensors with heat-conducting fluid in thermal wells.
8. Install outdoor air temperature sensors on north wall, complete with sun shield at designated location.

B. Room Instrument Mounting

1. Room instruments, including but not limited to wall mounted thermostats and sensors located in occupied spaces shall be mounted 53 inches above the finished floor unless otherwise shown.

C. Instrumentation Installed in Piping Systems

1. Thermometers and temperature sensing elements installed in liquid systems shall be installed in thermowells.
2. Gauges in piping systems subject to pulsation shall have snubbers.
3. Gauges for steam service shall have pigtail fittings with isolation valve.

D. Duct Smoke Detectors

1. Duct smoke detectors will be provided by the Fire Alarm System Contractor in supply and return air ducts in accordance with Division 16.
2. Contractor shall connect the DDC System to the auxiliary contacts provided on the Smoke Detector as required for system safeties and to provide alarms to the DDC system.

E. Airflow Measuring Stations (AFMS)

1. Outside Air AFMSs shall be located downstream from the Outside Air filters.
2. Pitot Tube type AFMS shall not be used if the expected velocity measurement is below 3.5 m/s (700 fpm) .

F. Differential air static pressure.

1. Supply Duct Static Pressure: Pipe the high-pressure tap to the duct using a pitot tube. Pipe the low-pressure port to a tee in the high-pressure tap tubing of the corresponding building static pressure sensor (if applicable) or to the location of the duct high-pressure tap and leave open to the plenum.
2. Return Duct Static Pressure: Pipe the high-pressure tap to the duct using a pitot tube. Pipe the low-pressure port to a tee in the low-pressure tap tubing of the corresponding building static pressure sensor.
3. Building Static Pressure: Pipe the low-pressure port of the pressure sensor to the static pressure port located on the outside of the building through a high-volume accumulator. Pipe the high-pressure port to a location behind a thermostat cover.
4. The piping to the pressure ports on all pressure transducers shall contain a capped test port located adjacent to the transducer.
5. Pressure transducers, other than those controlling VAV boxes, shall be located in field device panels, not on the equipment monitored or on ductwork.
6. Mount transducers in a location accessible for service without use of ladders or special equipment.
7. If the transmitter is wired in a homerun configuration to an AHU controller, the transmitter shall be located in the same enclosure as the air handling unit (AHU) controller(s) for the AHU serving the terminal units.

3.8 ACTUATORS:

A. Mount and link control damper actuators according to 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. Provide all mounting hardware and linkages for actuator installation.

B. Electric/Electronic

1. Dampers: Actuators shall be direct-mounted on damper shaft or jackshaft unless shown as a linkage installation. For low-leakage dampers with seals, the actuator shall be mounted with a minimum 5° available for tightening the damper seals. Actuators shall be mounted following manufacturer's recommendations.
2. Valves: Actuators shall be connected to valves with adapters approved by the actuator manufacturer. Actuators and adapters shall be mounted following the actuator manufacturer's recommendations.

3.9 PROGRAMMING:

A. Provide sufficient internal memory for the specified sequences of operation and trend logging. There shall be a minimum of 25% of available memory free within the primary controller 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. Point Naming standard shall be agreed upon between owner and BAS contractor. Refer to the Submittals section in – GENERAL of this specification.

C. Software Programming

1. Provide programming for the system and adhere to the sequences of operation provided. The contractor also shall provide all other system programming necessary for the operation of the system, but not specified in this document. Imbed into the control program sufficient comment statements to clearly describe each section of the program. The comment statements shall reflect the language used in the sequences of operation and be of different font and color in text editor. Use the appropriate technique based on one of the following programming types:

   a. Text-based:

      1) Must provide actions for all possible situations
      2) Must be modular and structured
      3) Must be commented
      4) Must provide line by line programming and compilation wizard to allow for ease of editing.

   b. Graphic-based:

      1) Must provide actions for all possible situations.
      2) Must provide programming and compilation wizard to allow for ease of editing.
      3) Must be documented.

D. Operator Interface

1. Standard graphics—Provide graphics for all mechanical systems and floor plans of the building. This includes each chilled water system, hot water system, chiller, boiler, air handler, and all terminal equipment. Point information on the graphic displays shall dynamically update. Show on each graphic all input and output points for the system. Also show relevant calculated points such as setpoints.
2. Show terminal equipment information on a "graphic" summary table. Provide dynamic information for each point shown.
3. The contractor shall provide all the labor necessary to install, initialize, start up, and troubleshoot all operator interface software and its 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.

4. Contractor shall provide necessary programming to create all reports referred to in Operator Interface Software section in – GENERAL of this specification

END OF SECTION 23 09 00

SECTION 23 21 13.33 – GEOTHERMAL HEAT PUMP AND LOOP PIPING SYSTEMS (HIGH DENSITY POLYETHYLENE)

PART 1 - GENERAL

1.1 SECTION INCLUDES: HDPE pipe used for geothermal heat pump water loop installations.

1.2 RELATED SECTIONS

A. Section 23 00 00, Basic Mechanical Requirements

B. Section 23 05 03, Piping Systems.

C. Section 23 05 53, Identification and Labeling.

D. Section 23 05 93, Test and Balance.

1.3 REFERENCES

A. ASTM D1683-98, Standard Test Method for Environmental Stress-Cracking of Ethylene Plastics.

B. ASTM D2447-99, Standard Specification for Polyethylene (PE) Plastic Pipe, Schedules 40 and 80, Based on Outside Diameter.

C. ASTM D2513-99, Standard Specification for Thermoplastics Gas Pressure Pipe, Tubing and Fittings.

D. ASTM D2683-98, Standard Specification for Socket-Type Polyethylene Fittings for Outside Diameter-controlled Polyethylene Pipe and Tubing.

E. ASTM D2837-98a, Standard Test Method for Obtaining Hydrostatic Design Basis for Thermoplastic Pipe Materials.

F. ASTM D3261-97, Standard Specification for Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing.

G. ASTM D3035-95, Standard Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Controlled Outside Diameter.

H. ASTM D3350-98a, Standard Specification for Polyethylene Plastics Pipe and Fitting Materials.

I. ASTM F714-97, Standard Specification for Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter.

J. ASTM F1055-98, Standard Specification for Electrofusion Type Polyethylene Fitting for Outside Diameter Controlled Polyethylene Pipe and Tubing.

1.4 SUBMITTALS FOR APPROVAL

A. Submit manufacturer's technical product data and installation instructions for pipe and fittings.

B. Submit names and certificates of successful completion of manufacturer training for the application specified.

C. Submit manufacturer's technical data on fusion machine to be used in joining the pipe and fittings.

D. Copies of pipe and fitting warranties must be submitted.

PART 2 - PRODUCTS

2.1 MATERIALS: Material Description- ASTM D3350- Type III, Grade PE4710

A. Pipe: The pipe shall be virgin resin with an allowance for on-site manufacturer re-processed resin. No recycled resin shall be used. All pipe and heat-fused materials shall be manufactured from a virgin polyethylene extrusion compound material in accordance with ASTM D-2513, Sections 4.1 and 4.2. The material shall maintain a 1600 psi (110.316 Bar) Hydrostatic Design Basis at 73.4° F (23.5 ° C) per ASTM D-2837, and shall be listed in PPI TR4 as a PE4710 piping formulation. The material shall be a high density extrusion compound having a cell classification of PE345434, PE355434, or PE345534 with a UV stabilizer of C, D, or E as specified in ASTM D-3350 with the following exception: this material shall exhibit zero failures (F0) when tested for a minimum of 192 hours under ASTM D-1693, Condition C, as required in ASTM D-3350.

1. Pipe shall be manufactured to outside diameters, wall thickness, and respective tolerances as specified in ASTM D-3035 or D-2447. Molded fittings shall be manufactured to dimensional specifications and requirements of ASTM D-2683 for socket fittings, ASTM D-3261 for butt/sidewall fittings, ASTM D-2513, Section 6.10.1 for Mechanical Stab fittings, and ASTM F-1055 for electrofusion fittings.

   a. Pipe with a diameter of 2 inches or less (nominal) shall be manufactured in accordance with ASTM D-3035 with a minimum[based on pressure rating]dimension ratio of 11.
   b. Pipe manufactured with a diameter of 3 inches (nominal) and larger shall be manufactured in accordance with ASTM D-3035 and ASTM F714 with a minimum[based on pressure rating]dimension ratio of 17, or ASTM D-2447 Schedule 40. If the pipe is used in a vertical bore application, it shall be manufactured in accordance with ASTM D-3035 with a minimum [based on pressure rating] dimension ratio of 11.

B. Fittings: The geothermal system pipe fittings which are molded shall be manufactured to the dimensional specifications and requirements of ASTM D-3261 for butt/sidewall fittings. The material used in the manufacturing of the fitting shall be the same approved extrusion material as the connecting pipe. For fabricated fittings, a minimum 'quick-burst' strength of the fittings shall not be less than that of the pipe, nor less than four times the long-term water-rated working pressure.

1. Purpose-designed U-bend fittings shall be used instead of L+Street for ease of insertion.

C. Joints: The approved joints are heat fusion, flanging, transition fittings and proof-tested, approved mechanical "couplers". Fusion joints shall be made by trained and qualified construction crew staff. The butt fusion machine used to make the joints shall encompass the following features:

1. Guide rods shall be in a plane that passes through the centerline of the pipe, thus canceling the bending forces in the machine caused by the fusion forces.
2. The pipe clamps shall have the strength to ‘round-up’ the pipe close to the fusion joint. They must be adjustable for removal of high/low mismatch of pipe walls and clamp each piece on continuing straight centerline.
3. The pipe facing device shall be capable of rapid facing of the pipe ends to a perfectly flat surface, so when the ends are brought together, there is 100 percent plastic contact.
4. The facer may be hand or electric powered for pipe sizes up to 2 inches (5.1 cm), and electrically powered for pipe sizes up to 8 inches (20.3 cm).
5. The facer shall have precisely machined stops to lock the facer squarely between the clamping jaws at the end of the face off.
6. The socket fusion machine used to make the joints shall encompass the following features:
    a. A set of metal socket faces which are dimensionally accurate according to current industry practices. The surface of the socket face that will be in direct contact with the pipe or fitting shall be smooth and coated with a high quality non-stick coating.
    b. Temperature-indicating crayons or a surface pyrometer. One temperature crayon shall be for the proper ‘low’ end temperature indication and another crayon shall be for indicating the ‘high’ end temperature. Use pipe manufacturer’s recommended fusion temperature range.
    c. A depth gauge that is sized according to pipe diameter and corresponding fusion fitting socket depth. The depth gauge shall be used to locate the cold ring the proper distance from the pipe end.
    d. A metal locking cold ring clamp which supplies support for the entire circumference of the piping material. Cold ring shall have the ability to keep the pipe end round. The cold ring shall be used to limit the pipe depth entry into the socket face and fusion fitting socket.
    e. A timing device that emits an audible tone and a timing light on one second intervals. Timer shall be used to determine proper heat cycle for the pipe and fitting. Use pipe manufacturer’s recommended heating times.
    f. A number of clean, dry, 100 percent cotton rags used to clean the socket heater faces after each fusion application. Rags shall be free of any cleaning solvents, grease, or dirt.
7. Install piping in accordance with manufacturer’s written instructions. The pipe and fittings must be joined using the butt, socket, electrofusion, or fusion process. No other method is acceptable. The vertical loop take-off tee fittings may be made using tees or the saddle fusion process on header piping 1.25 inch (3.18 cm) and above. Exercise extreme caution to completely remove the cutout on saddle tees. Bell reductions shall be used at all pipe reductions to eliminate trapped air.
8. Use reducing socket tees when fabricating socket type reducing headers. Consult with manufacturer for available fittings and fabricated headers.
9. Avoid sharp bends in piping. Consult pipe manufacturer for minimum bend radius. Install elbow fittings for bends which require tighter radii than manufacturer recommends. Use only continuous pipe in sharp bends.

D. Marking: Each pipe shall be permanently indent marked with the manufacturer's name, nominal size, pressure rating, relevant ASTM standards, cell classification number and date of manufacture.

1. Each fitting shall be identified with the manufacturer's name, nominal size, pressure rating, relevant ASTM standards and date of manufacturer.

E. Packaging, Handling, and Storage: The pipe and fittings shall be packaged, handled and stored in accordance with the approved manufacturer's general guidance and recommendations.

Table Of Water Pressure Ratings at 73.4ºF (23.5ºC) for DR-PR PE 4710 Plastic Pipe:

Dimension Ratio	Pressure Rating, psi	Pressure Rating, Bar
11	200	11.03
17	125	6.9

2.2 SOURCE QUALITY CONTROL

A. Obtain pipe and fittings from compatible manufacturers.

B. The pipe and fittings manufacturer shall have in place a functional quality assurance program. Such QC/QA programs shall deal with quality and workmanship, OA verification, OA rejection and have OA record retention systems in place.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install piping system per Sect. 23 00 00.

B. Join pipe and fittings by approved methods described above.

C. Pipe Supports

1. Space pipe supports per following table or per applicable manufacturer's instructions, if available:

Size (in.)	Maximum spacing
1.25	2 ft 9 in.
2	3 ft 0 in.
3	3 ft 6 in.
4	3 ft 9 in.
6	3 ft 9 in.

2. Remove sharp edges and burrs of hanger parts which contact pipe.
3. Do not rigidly clamp or force pipe into position by means of hangers.
4. Support vertical pipe with riser clamps. Restrict side motion by means of oversize U-bolts.
5. Support shall cradle insulation and pipe with minimum saddle coverage of 150 degrees and a length of 12". This cradle shall be galvanized sheet metal with a minimum gauge of 18.

D. Identification/Labeling: Sect. 23 05 53.

E. Insulation. All HDPE piping and fittings (above ground) shall be insulated with a tubing insulation having minimum thickness of ½" wall and flame/smoke rating of 25/50. Piping below ground should not be insulated.

3.2 REPAIR/RESTORATION

A. Repair leaks found when testing by cutting the damaged section and replacing it with an approved socket- or butt-fused piece (or approved mechanical connector). Large diameter polyethylene piping may be repaired by use of a torch.

3.3 FIELD QUALITY CONTROL

A. Pressure/Leak Test: Per Chapter 12 of International Mechanical Code.

3.4 CLEANING

A. Flush piping system with potable water at 2 fps and observe for free flow.

B. Remove material or obstructions that interfere with full flow.

C. Adjust piping to remove kinks or crimping in piping, U-bends, and header system.

3.5 GROUNDING

A. Any Copper or Steel piping or equipment component that is used in the system must have a bonded ground established. Make sure that the grounding wire is bonded to the raw metal and not separated by paint or other coating.

END OF SECTION 23 21 14

SECTION 23 21 16 – HYDRONIC SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. Specifications throughout all Divisions of the Project Manual are directly applicable to this Section, and this Section is directly applicable to them.

1.2 SUMMARY

A. Perform all Work required to provide and install air vents, pressure gauges, thermometers, strainers, air separators, expansion tanks, relief valves, water flow measuring and balancing systems, and water flow integrating meters as indicated by the Contract Documents with supplementary items necessary for their proper installation and operation.

1.3 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. ANSI/ASME Boilers and Pressure Vessel Code, Section VIII, Division 1 Design and Fabrication of Pressure Vessels.

1.4 QUALITY ASSURANCE

A. Manufacturer: For each product specified, provide components by the same manufacturer throughout.

1.5 SUBMITTALS

A. Product Data:

1. Submit Shop Drawings and product data, including component sizes, rough-in requirements, service sizes, and finishes.
2. Submit manufacturer's installation instructions.

1.6 EXTRA MATERIALS

A. Provide the Owner with one differential pressure meter kit from the installed balancing valve manufacturer for use with circuit balancing valves installed within this project. Kit shall include meter, hoses, connection accessories, circular slide rule, carrying case and valve manufacturer's curve charts. If the contractors scope of the project is a renovation in an existing building and the balance valves match existing manufacturer and models the contractor shall inquire with Owners maintenance staff if a meter kit is required.

PART 2 - PRODUCTS

2.1 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.

2.2 Manufacturers

A. Air Separators: Thrush, Taco, Spirotherm, Water Relief Valves: Keckley, Watts, Bell & Gossett.

B. Coil Package Valve Sets: Nexus, Tour and Andersson

C. Integrating Flowmeters: Panametrics, Balance Master, Controlotron, EMCO.

D. Pressure Gauges: Ashcroft, Dwyer, Weksler, Marsh Instrument, H.O. Trerice, Moeller Instrument Co, Weiss.

E. Thermometers: Ashcroft, Dwyer, Marsh Instrument, Weksler, Moeller Instrument, H.O. Trerice, Weiss, Controlotron Corporation.

F. Pump Suction Fittings: Bell and Gossett, Taco, Victaulic.

G. Strainers: Keckley, Mueller, Muessco, Strainers, Inc., Grinnell, Victaulic.

2.3 AUTOMATIC AIR VENTS

A. No Automatic air valves are to be used on this project. .

2.4 AIR SEPARATORS

A. Bronze tank, flanged inlet and outlet connections, separate top fittings for make-up line connection, automatic air vent, and bottom connection for blow-down and cleaning. ASME construction and stamped for 125 psig design pressure.

B. Must be a Coalescing type. Air separators are to be coalescing type

C. Units shall be full line size or minimum of 1-1/4” with reducers to pipe size.

2.5 WATER RELIEF VALVES

A. None on the geothermal system

2.6 Coil PaCKAGE Valve sets

A. Install per manufacturers recommendations and instructions on heat pump units using 1” hose kits on all units with reducers at the heat pumps: valve bodies shall be manufactured from brass ASTM B 283 capable of working at a maximum temperature of 370 F. at a pressure of 600 psi. The valve body is a Y type capable of working and maintaining flow rate at a differential pressure range between 1 to 2 psi.

B. . The valve shall have a blow down valve to clear fine particulate from the cartridge, and two, 1/4" threaded brass ports located on the inlet side of the valve use to acquire a differential pressure measurement. The ports shall have caps with O-ring seals. The valves shall be full port valves.

C. Supply side coil package shall including a ball valve Y strainer combo with PT port, union, and blow down. Return side coil package shall include a union port fitting with PT port, , union, and male threaded tail piece..

2.7 INTEGRATING FLOWMETERS

A. General:

1. Install in main building geothermal piping systems and on fluid cooler as shown on the Drawings.
2. Integrating flowmeters must have the following characteristics:
   a. Uses the transit-time principle of ultrasonic flow metering.
   b. Flow sensors that are portable, clamp-on type and that do not come in contact with the fluid or protrude into the flow path.
3. Flow element shall be installed in a straight run of pipe in accordance to manufacturer’s guidelines for the specific installation in order to maintain rated accuracy.

B. Flow Stations:

1. Flow stations shall consist of dual flow sensors and carriers mounted in the transverse arrangement with laminated or metal identification tag on chain giving pipe size, meter series, and station identification.
2. Maximum fluid operating ranges:
   a. Pressure: 0 to 150 psig.

b. Temperature: 32 degrees F to 250 degrees F.

3. Flow stations shall be of steel construction.

C. Flow Meter:

1. Provide a Onicon System 10 or equivalent meter that instantaneously displays flow and/or changes in flow by means of a high-visibility, integral, backlit LCD, dual channel (one for chilled water, the other for steam condensate or hot water as noted on Drawings) that displays instantaneous flow rate in GPM and total gallons. Charts and tables are not acceptable. Register heating and cooling modes separately on each meter.
2. Each channel shall have dual outputs for each of the displayed values. Outputs shall be 4– 20 mA and TTL pulse rate, each proportional to display values.
3. Meter shall have positive zero flow indication.
4. Meter shall be complete with adequate lengths of flow cables attached to sensors, with installation and operating instructions.
5. Meter shall be capable of interfacing with and delivering a signal to the building automation system.

2.8 FLEXIBLE HOSE

A. Furnish and install Amber-Booth Metalflex flexible hose connectors or accepted substitution. Hose and braid shall be bronze and male fittings shall be steel. All geothermal heat pumps to have 1” size hose regardless of connection size and reduce at the heat pump connection.

B. Install connector in a straight line without offset. Piping shall be supported so that connector does not carry pipe load.

C. Install in line without twisting connector.

D. . All hose shall be full port.

2.9 PRESSURE GAUGES

A. Application: Provide pressure gauges as indicated on Drawings; 4-½ inch face diameter with 0.5 percent accuracy of full span, Grade 2A, ANSI B40.1.

B. Gauge Ranges:

1. Provide 0 - 160 psi gauges for 150 psi geothermal water service.

C. For each gauge, provide bronze gauge lock and globe type bleed valve:

1. Similar to Jenkins 750, Crane 362E, Stockham B-66, Powell 120 or accepted substitution of the pressure rating for the system installed.

2.10 THERMOMETERS

A. Placement: Provide, where shown on Drawings and as indicated below, thermometers of suitable range for the service required. Provide thermometers on the inlet and outlet sides of all coils, heat exchangers, and heat generators.

B. Furnish thermometers for services in the following ranges and divisions with English scales:

1. Condenser water:

   a. Range: 0 to 120 degrees F.
   b. Division: 1 degrees F.

C. Sockets: Provide thermometer sockets at all thermometer locations. Provide thermometer sockets only, fitted with plug and chain and conforming to the requirements specified for thermometers. Install all sockets vertical or at a 45-degree vertical angle to permit filling with conducting liquid for tests.

D. Construction: Provide thermometers that are 9 inches long with an etched glass enclosed scale of 2-degree increments, a cast aluminum case, and red reading mercury. Furnish an adjustable, angle-type scale with a swivel nut connection into ¾-inch brass separable sockets. Use a 3-1/2 inch stem length for all pipe sizes up through 8 inches, a 6-inch stem length for 10 inch pipe size, and a 9-inch stem length for pipe sizes larger than 10 inches.

E. Extensions: Where thermometers are installed in insulated lines, use extension-neck separable sockets.

F. Remote Thermostats: Furnish remote bulb thermometers where specified and shown. Provide thermometers with corrosion-resistant movements set in cast aluminum cases with black enamel finish.

   1. Furnish dials 4-½ inches in diameter, with black numbers on white dials.
   2. Use copper capillary tubing protected by a spiral or double-braided bronze armor.

2.11 PUMP SUCTION FITTINGS

A. Fitting: Angle pattern, cast iron body, flanged for over 2 inches, rated for 125 psig working pressure with inlet vanes, cylinder strainer with 3/16-inch diameter openings, disposable fine mesh strainer to fit over cylinder strainer, and permanent magnet located in flow stream and removable for cleaning.

B. Accessories: Adjustable foot support, blowdown tapping in bottom, gauge tapping inside.

C. Provide mated flanges at all pump suctions.

D. All small body circulators to have isolation flanges used on both sides of pumps for easy servicing. Pumps must be installed with motor in the vertical up position.

2.12 STRAINERS

A. 2 inches and smaller: Screwed brass or iron body, Y pattern with 1/32 inch stainless steel perforated screen. 150 psi or 300 psi pressure rating to match system pressure.

B. 2-1/2 inches to 4 inches: Flanged iron body, Y pattern with 3/64 inch stainless steel perforated screen. 150 psi or 300 psi pressure rating to match system pressure.

PART 3 - EXECUTION

3.1 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. Provide air separator on system as shown on Drawings.

D. Provide valved drain and hose connection on entering pipe connections.

E. Provide pump suction fitting on suction side of base mounted centrifugal pumps. Remove temporary strainers after cleaning systems. Clean all permanent strainers after circulating systems for a minimum of 48 hours at full capacity.

F. Support pump fittings with floor mounted pipe and flange supports.

G. Install all pressure gauges so that they are easily readable.

H. Pressure gauges need not be furnished across in-the-line circulators.

END OF SECTION 23 21 30

SECTION 23 21 23 - HYDRONIC PUMPS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Close-coupled, in-line centrifugal pumps.
2. Close-coupled, end-suction centrifugal pumps.
3. Separately coupled, horizontally mounted, in-line centrifugal pumps.
4. Separately coupled, vertically mounted, in-line centrifugal pumps.
5. Separately coupled, base-mounted, end-suction centrifugal pumps.

1.2 DEFINITIONS

A. Buna-N: Nitrile rubber.

B. EPT: Ethylene propylene terpolymer.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of pump. Include certified performance curves and rated capacities, operating characteristics, furnished specialties, final impeller dimensions, and accessories for each type of product indicated. Indicate pump's operating point on curves.

B. Shop Drawings: For each pump.

1. Show pump layout and connections.
2. Include setting drawings with templates for installing foundation and anchor bolts and other anchorages.
3. Include diagrams for power, signal, and control wiring.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For pumps to include in emergency, operation, and maintenance manuals.

1.5 MAINTENANCE MATERIAL SUBMITTALS

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. Mechanical Seals: 2 mechanical seal(s) for each pump.

PART 2 - PRODUCTS

2.1 CLOSE-COUPLED, IN-LINE CENTRIFUGAL PUMPS

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

B. Basis-of-Design Product: Subject to compliance with requirements, provide or comparable product by one of the following:

1. Armstrong Pumps Inc.
2. Grundfos Pumps Corporation.
3. ITT Corporation; Bell & Gossett.
4. TACO Incorporated.

C. Description: Factory-assembled and -tested, centrifugal, overhung-impeller, close-coupled, in-line pump as defined in HI 1.1-1.2 and HI 1.3; designed for installation with pump and motor shafts mounted horizontally or vertically.

D. Pump Construction:

1. Casing: Radially split, SS volutes, with threaded gage tappings at inlet and outlet, replaceable wear rings, and threaded isolation type companion-flange connections.
2. Impeller: ASTM B 584, SS; statically and dynamically balanced, keyed to shaft, and secured with a locking cap screw. For constant-speed pumps, trim impeller to match specified performance.
3. Pump Shaft: Stainless steel.
4. Seal: Mechanical seal consisting of carbon rotating ring against a ceramic seat held by a stainless-steel spring, and EPT bellows and gasket. Include water slinger on shaft between motor and seal.
5. Pump Bearings: Permanently lubricated ball bearings.

E. Motor: Single speed and rigidly mounted to pump casing.

1. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Division 23 Section "Common Motor Requirements for HVAC Equipment."

   a. Enclosure: Open, dripproof.
   b. Enclosure Materials: Cast iron with SS volute.
   c. Motor Bearings: Grease-lubricated ball bearings.
   d. Efficiency: Premium efficient.

3. Grounding. Pump casing and flanges are to be grounded to heat pump.

2.2 CLOSE-COUPLED, END-SUCTION CENTRIFUGAL PUMPS

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

B. Basis-of-Design Product: Subject to compliance with requirements, provide or comparable product by one of the following:

1. Armstrong Pumps Inc.

2. Grundfos Pumps Corporation.
3. ITT Corporation; Bell & Gossett.
4. TACO Incorporated.

C. Description: Factory-assembled and -tested, centrifugal, overhung-impeller, close-coupled, end-suction pump as defined in HI 1.1-1.2 and HI 1.3; designed for installation with pump and motor shafts mounted horizontally.

D. Pump Construction:

1. Casing: Radially split, SS volute, with replaceable bronze wear rings, drain plug at bottom and air vent at top of volute, threaded gage tappings at inlet and outlet, and flanged connections.
2. Impeller: ASTM B 584, cast bronze or SS; statically and dynamically balanced, keyed to shaft, and secured with a locking cap screw. For constant-speed pumps, trim impeller to match specified performance.
3. Pump Shaft: Stainless steel.
4. Mechanical Seal: Carbon rotating ring against a ceramic seat held by a stainless-steel spring, and EPT bellows and gasket. Include water slinger on shaft between motor and seal.
5. Pump Bearings: Permanently lubricated ball bearings.

E. Motor: Single speed and rigidly mounted to pump casing with integral pump support.

1. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Division 23 Section "Common Motor Requirements for HVAC Equipment."

a. Enclosure: Open, dripproof.
b. Enclosure Materials: SS on all materials in contact with geothermal water.
c. Motor Bearings: Grease-lubricated ball bearings.
d. Efficiency: Premium efficient.

2.3 SEPARATELY COUPLED, HORIZONTALLY MOUNTED, IN-LINE CENTRIFUGAL PUMPS

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

B. Basis-of-Design Product: Subject to compliance with requirements, provide or comparable product by one of the following:

1. Armstrong Pumps Inc.
2. Grundfos Pumps Corporation.
3. ITT Corporation; Bell & Gossett.
4. TACO Incorporated.

C. Description: Factory-assembled and -tested, centrifugal, overhung-impeller, separately coupled, in-line pump as defined in HI 1.1-1.2 and HI 1.3; designed for installation with pump and motor shafts mounted horizontally.

D. Pump Construction:

1. Casing: Radially split, SS, with threaded gage tappings at inlet and outlet, and threaded union-end connections.
2. Impeller: ASTM B 584, cast bronze or SS; statically and dynamically balanced, and keyed to shaft. For pumps not frequency-drive controlled, trim impeller to match specified performance.
3. Pump Shaft: Stainless steel.
4. Mechanical Seal: Carbon rotating ring against a ceramic seat held by a stainless-steel spring, and EPT bellows and gasket. Include water slinger on shaft between motor and seal.
5. Pump Bearings: Permanently lubricated ball bearings.

E. Shaft Coupling: Molded-rubber insert with interlocking spider capable of absorbing vibration.

F. Motor: Single speed and rigidly mounted to pump casing.

1. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Division 23 Section "Common Motor Requirements for HVAC Equipment."

   a. Enclosure: Open, dripproof.
   b. Enclosure Materials: SS on all materials in contact with geothermal water.
   c. Motor Bearings: Permanently lubricated ball bearings.
   d. Efficiency: Premium efficient.

2.4 SEPARATELY COUPLED, BASE-MOUNTED, END-SUCTION CENTRIFUGAL PUMPS

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

B. Basis-of-Design Product: Subject to compliance with requirements, provide or comparable product by one of the following:

1. Armstrong Pumps Inc.
2. Aurora Pump; Division of Pentair Pump Group.
3. Grundfos Pumps Corporation.
4. ITT Corporation; Bell & Gossett.
5. Patterson Pump Co.; a subsidiary of the Gorman-Rupp Co.
6. Peerless Pump Company.
7. TACO Incorporated.

C. Description: Factory-assembled and -tested, centrifugal, overhung-impeller, separately coupled, end-suction pump as defined in HI 1.1-1.2 and HI 1.3; designed for base mounting, with pump and motor shafts horizontal.

D. Pump Construction:

1. Casing: Radially split, cast iron, with replaceable bronze wear rings, threaded gage tappings at inlet and outlet, drain plug at bottom and air vent at top of volute, and flanged connections. Provide integral mount on volute to support the casing, and provide attached piping to allow removal and replacement of impeller without disconnecting piping or requiring the realignment of pump and motor shaft.

2. Impeller: ASTM B 584, cast bronze; statically and dynamically balanced, keyed to shaft, and secured with a locking cap screw. For pumps not frequency-drive controlled, trim impeller to match specified performance.
3. Pump Shaft: Stainless steel.
4. Seal: Mechanical seal consisting of carbon rotating ring against a ceramic seat held by a stainless-steel spring, and EPT bellows and gasket.
5. Pump Bearings: Grease-lubricated ball bearings in cast-iron housing with grease fittings.

E. Shaft Coupling: Molded-rubber insert and interlocking spider capable of absorbing vibration. Couplings shall be drop-out type to allow disassembly and removal without removing pump shaft or motor. EPDM coupling sleeve for variable-speed applications.

F. Coupling Guard: Dual rated; ANSI B15.1, Section 8; OSHA 1910.219 approved; steel; removable; attached to mounting frame.

G. Mounting Frame: Welded-steel frame and cross members with integral drain rim, factory fabricated from ASTM A 36/A 36M channels and angles. Provide continuous drip canal around sides and back of pump, sloped to threaded drain opening. Fabricate to mount pump casing, coupling guard, and motor with provisions for grouting.

H. Motor: Single speed, secured to mounting frame, with adjustable alignment.

1. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Division 23 Section "Common Motor Requirements for HVAC Equipment."

a. Enclosure: Open, dripproof.
b. Enclosure Materials: Cast iron.
c. Motor Bearings: Permanently lubricated ball bearings.
d. Efficiency: Premium efficient.

2.5 PUMP SPECIALTY FITTINGS

A. Suction Diffuser:

1. Angle pattern.
2. 175-psig pressure rating, cast-iron body and end cap, pump-inlet fitting.
3. Bronze startup and bronze or stainless-steel permanent strainers.
4. Bronze or stainless-steel straightening vanes.
5. Drain plug.
6. Factory-fabricated support.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine equipment foundations and anchor-bolt locations for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for piping systems to verify actual locations of piping connections before pump installation.

C. Examine foundations and inertia bases for suitable conditions where pumps are to be installed.

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

3.2 PUMP INSTALLATION

A. Comply with HI 1.4 and HI 2.4.

B. Install pumps to provide access for periodic maintenance including removing motors or cartridges, impellers, couplings, and accessories.

C. Independently support pumps and piping so weight of piping is not supported by pumps and weight of pumps is not supported by piping.

D. Install pumps over emergency drain pan of unit so water can be contained.

E. Automatic Condensate Pump Units: Install units for collecting condensate and extend to open drain.

F. Equipment Mounting: Install base-mounted pumps on cast-in-place concrete equipment base(s) using elastomeric pads. Comply with requirements for equipment bases specified in Division 03 Section " Miscellaneous Cast-in-Place Concrete." Comply with requirements for vibration isolation devices specified in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."

1. Minimum Deflection: 1 inch.
2. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases.
3. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around full perimeter of concrete base.
4. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
5. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
6. Install anchor bolts to elevations required for proper attachment to supported equipment.
7. Install on 4-inch-high concrete base.

G. Equipment Mounting: Install in-line pumps with continuous-thread hanger rods and spring hangers with vertical-limit stop of size required to support weight of in-line pumps.

1. Comply with requirements for seismic-restraint devices specified in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."
2. Comply with requirements for hangers and supports specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment."

H. Provide drains for bases and seals, piped to nearest floor drain.

3.3 ALIGNMENT

A. Engage a factory-authorized service representative to perform alignment service.

B. Comply with requirements in Hydronics Institute standards for alignment of pump and motor shaft. Add shims to the motor feet and bolt motor to base frame. Do not use grout between motor feet and base frame.

C. Comply with pump and coupling manufacturers' written instructions.

D. After alignment is correct, tighten foundation bolts evenly but not too firmly. Completely fill baseplate with non-shrink, nonmetallic grout while metal blocks and shims or wedges are in place. After grout has cured, fully tighten foundation bolts.

3.4 CONNECTIONS

A. Where installing piping adjacent to pump, allow space for service and maintenance.

B. Connect piping to pumps. Install valves that are same size as piping connected to pumps.

C. Install suction and discharge pipe sizes equal to or greater than diameter of pump nozzles.

D. All heat pumps must have 1” flanges and pipes. Reduce at equipment inlet connections only.

E. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems." Pump housings and flanges must be grounded to equipment ground.

3.5 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.
2. Check piping connections for tightness.
3. Clean strainers on piping.
4. Perform the following startup checks for each pump before starting:

    a. Verify bearing lubrication.
    b. Verify that pump is free to rotate by hand and that pump for handling hot liquid is free to rotate with pump hot and cold. If pump is bound or drags, do not operate until cause of trouble is determined and corrected.
    c. Verify that pump is rotating in the correct direction.

5. Prime pump by opening suction valves and closing drains, and prepare pump for operation.
6. Start motor.
7. Open discharge valve slowly.

3.6 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain hydronic pumps.

END OF SECTION 23 21 23

SECTION 23 31 13 - METAL DUCTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Single-wall rectangular ducts and fittings.
2. Single-wall round and flat-oval 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 "HVAC Casings" for factory- and field-fabricated casings for mechanical equipment.
3. Division 23 Section "Air Duct Accessories" for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, and flexible ducts.

1.2 PERFORMANCE REQUIREMENTS

A. Delegated Duct Design: Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, shall comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and performance requirements and design criteria indicated in "Duct Schedule" Article.

B. Structural Performance: Duct hangers and supports shall withstand the effects of gravity loads and stresses within limits and under conditions described in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"

C. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

1.3 SUBMITTALS

A. Product Data: For each type of the following products:

1. Liners and adhesives.
2. Sealants and gaskets.

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 and vibration isolation.

C. Delegated-Design Submittal:

1. Sheet metal thicknesses.
2. Joint and seam construction and sealing.
3. Reinforcement details and spacing.
4. Materials, fabrication, assembly, and spacing of hangers and supports.

D. Coordination Drawings: Plans, drawn to scale, on which the following items are shown and co-ordinated 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.

E. Welding certificates.

F. Field quality-control reports.

1.4 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum," for aluminum supports. AWS D9.1M/D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.

B. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports.

2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum," for aluminum supports.
3. AWS D9.1M/D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.

C. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-Up."

D. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6.4.4 - "HVAC System Construction and Insulation."

PART 2 - PRODUCTS

2.1 SINGLE-WALL RECTANGULAR DUCTS AND FITTINGS

A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.

B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular Duct/Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Duct/Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

D. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 4, "Fittings and Other Construction," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.2 DOUBLE-WALL RECTANGULAR DUCTS AND FITTINGS

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

1. McGill AirFlow LLC.
2. Sheet Metal Connectors, Inc.
3. Lindab, Inc.
4. Other acceptable manufacturers offering equivalent products.

B. Rectangular Ducts: Fabricate ducts with indicated dimensions for the inner duct.

C. Outer Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.

D. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular Duct/Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support inter-

vals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

E. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Duct/Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

F. Interstitial Insulation: Fibrous-glass liner complying with ASTM C 1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."

1. Maximum Thermal Conductivity: 0.27 Btu x in./h x sq. ft. x deg F at 75 deg Fmean temperature.
2. Install spacers that position the inner duct at uniform distance from outer duct without compressing insulation.
3. Coat insulation with antimicrobial coating.
4. Cover insulation with polyester film complying with UL 181, Class 1.

G. Inner Duct: Minimum 0.028-inch solid sheet steel.

H. Formed-on Transverse Joints (Flanges): Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular Duct/Traverse 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."

I. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Duct/Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.3 SINGLE-WALL ROUND AND FLAT-OVAL 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:

a. Lindab Inc.
b. McGill AirFlow LLC.
c. SEMCO Incorporated.
d. Sheet Metal Connectors, Inc.
e. Spiral Manufacturing Co., Inc.
f. Other acceptable manufacturers offering equivalent products.

B. Flat-Oval Ducts: Indicated dimensions are the duct width (major dimension) and diameter of the round sides connecting the flat portions of the duct (minor dimension).

C. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Round Duct Transverse Joints," for 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 in Diameter: Flanged.

D. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Round Duct Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

1. Fabricate round ducts larger than 90 inches in diameter with butt-welded longitudinal seams.
2. Fabricate flat-oval ducts larger than 72 inches in width (major dimension) with butt-welded longitudinal seams.

E. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.4 DOUBLE-WALL ROUND AND FLAT-OVAL DUCTS AND FITTINGS

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

1. Lindab Inc.
2. McGill AirFlow LLC.
3. SEMCO Incorporated.
4. Sheet Metal Connectors, Inc.
5. Other acceptable manufacturers offering equivalent products.

B. Flat-Oval Ducts: Indicated dimensions are the duct width (major dimension) and diameter of the round sides connecting the flat portions of the duct (minor dimension) of the inner duct.

C. Outer Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on static-pressure class unless otherwise indicated.

1. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Round Duct Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

   a. Transverse Joints in Ducts Larger Than 60 Inches in Diameter: Flanged.

2. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Round Duct Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

a. Fabricate round ducts larger than 90 inches in diameter with butt-welded longitudinal seams.
b. Fabricate flat-oval ducts larger than 72 inches in width (major dimension) with butt-welded longitudinal seams.

3. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

D. Inner Duct: Minimum 0.028-inch perforated galvanized sheet steel having 3/32-inch-diameter perforations, with overall open area of 23 percent.

E. Interstitial Insulation: Fibrous-glass liner complying with ASTM C 1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."

1. Maximum Thermal Conductivity: 0.27 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.
2. Install spacers that position the inner duct at uniform distance from outer duct without compressing insulation.
3. Coat insulation with antimicrobial coating.
4. Cover insulation with polyester film complying with UL 181, Class 1.

2.5 SHEET METAL MATERIALS

A. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.

1. Galvanized Coating Designation: G90.
2. Finishes for Surfaces Exposed to View: Mill phosphatized.

C. 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.

D. Aluminum Sheets: Comply with ASTM B 209 Alloy 3003, H14 temper; with mill finish for concealed ducts, and standard, one-side bright finish for duct surfaces exposed to view.

E. 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.

F. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.6 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:

   a. CertainTeed Corporation; Insulation Group.
   b. Johns Manville.
   c. Knauf Insulation.
   d. Owens Corning.
   e. Maximum Thermal Conductivity:

      1) Type I, Flexible: 0.27 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.
      2) Type II, Rigid: 0.23 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.

2. 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.
3. 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, 0.106-inch-diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.
2. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick galvanized steel; with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.

C. Shop Application of Duct Liner: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 7-11, "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.
7. Secure liner with mechanical fasteners 4 inches from corners and at intervals not exceeding 12 inches transversely; at 3 inches from transverse joints and at intervals not exceeding 18 inches 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 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 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.

2.7 SEALANT AND GASKETS

A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.

B. Two-Part Tape Sealing System:

1. Tape: Woven cotton fiber impregnated with mineral gypsum and modified acrylic/silicone activator to react exothermically with tape to form hard, durable, airtight seal.
2. Tape Width: 4 inches.
3. Sealant: Modified styrene acrylic.
4. Water resistant.
5. Mold and mildew resistant.
6. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
7. Service: Indoor and outdoor.
8. Service Temperature: Minus 40 to plus 200 deg F.
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, 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 and shall be rated for 10-inch wg 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.

2.8 HANGERS AND SUPPORTS

A. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.

B. Hanger Rods for Corrosive Environments: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.

C. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct."

D. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.

E. Steel Cables for Stainless-Steel Ducts: Stainless steel complying with ASTM A 492.

F. Steel Cable End Connections: Cadmium-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.

G. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.

H. Trapeze and Riser Supports:

1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.
2. Supports for Stainless-Steel Ducts: Stainless-steel shapes and plates.
3. Supports for Aluminum Ducts: Aluminum or galvanized steel coated with zinc chromate.

PART 3 - EXECUTION

3.1 DUCT INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and Coordination Drawings.

B. Install ducts according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.

C. Install round and flat-oval 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, 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.

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.

L. Protect duct interiors from moisture, construction debris and dust, and other foreign materials. Comply with SMACNA's "IAQ Guidelines for Occupied Buildings Under Construction," Appendix G, "Duct Cleanliness for New Construction Guidelines."

3.2 INSTALLATION OF EXPOSED DUCTWORK

A. Protect ducts exposed in finished spaces from being dented, scratched, or damaged.

B. Trim duct sealants flush with metal. Create a smooth and uniform exposed bead. Do not use two-part tape sealing system.

C. Grind welds to provide smooth surface free of burrs, sharp edges, and weld splatter. When welding stainless steel with a No. 3 or 4 finish, grind the welds flush, polish the exposed welds, and treat the welds to remove discoloration caused by welding.

D. Maintain consistency, symmetry, and uniformity in the arrangement and fabrication of fittings, hangers and supports, duct accessories, and air outlets.

E. Repair or replace damaged sections and finished work that does not comply with these requirements.

3.3 ADDITIONAL INSTALLATION REQUIREMENTS FOR COMMERCIAL KITCHEN HOOD EXHAUST DUCT

A. Install commercial kitchen hood exhaust ducts without dips and traps that may hold grease, and sloped a minimum of 2 percent to drain grease back to the hood.

B. Install fire-rated access panel assemblies at each change in direction and at maximum intervals of 20 feet in horizontal ducts, and at every floor for vertical ducts, or as indicated on Drawings. Locate access panel on top or sides of duct a minimum of 1-1/2 inches from bottom of duct.

C. Do not penetrate fire-rated assemblies except as allowed by applicable building codes and authorities having jurisdiction.

3.4 DUCT SEALING

A. Seal ducts for duct static-pressure, seal classes, and leakage classes specified in "Duct Schedule" Article according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

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 and Lower: Seal Class B.
6. Unconditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 2-Inch wg: 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 and Lower: Seal Class C.
10. Conditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 2-Inch wg: Seal Class B.
11. Conditioned Space, Exhaust Ducts: Seal Class B.
12. Conditioned Space, Return-Air Ducts: Seal Class C.

3.5 HANGER AND SUPPORT INSTALLATION

A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 5, "Hangers and Supports."

B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.

1. Where practical, install concrete inserts before placing concrete.
2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches thick.
4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.

C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches of each elbow and within 48 inches 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.

F. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

3.6 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.

3.7 PAINTING

A. Paint interior of metal ducts that are visible through registers and grilles and that do not have duct liner. Apply one coat of flat, black, latex paint over a compatible galvanized-steel primer.

3.8 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Leakage Tests:

1. Comply with SMACNA's "HVAC Air Duct Leakage Test Manual." Submit a test report for each test.
2. Test the following systems:

   a. All ducts with a pressure class lower than 2-inch WG: Test representative duct sections totaling no less than 25 percent of total installed duct area for each designated pressure class.
   b. Supply Ducts with a Pressure Class of 2-Inch wg or Higher: Test representative duct sections totaling no less than 100 percent of total installed duct area for each designated pressure class.

c. Return Ducts with a Pressure Class of 2-Inch wg or Higher: Test representative duct sections totaling no less than 100 percent of total installed duct area for each designated pressure class.
d. Exhaust Ducts with a Pressure Class of 2-Inch wg or Higher: Test representative duct sections totaling no less than 100 percent of total installed duct area for each designated pressure class.
e. Outdoor Air Ducts with a Pressure Class of 2-Inch wg or Higher: Test representative duct sections totaling no less than 100 percent of total installed duct area for each designated pressure class.

3. Disassemble, reassemble, and seal segments of systems to accommodate leakage testing and for compliance with test requirements.
4. Test for leaks before applying external insulation.
5. Conduct tests at static pressures equal to maximum design pressure of system or section being tested. If static-pressure classes are not indicated, test system at maximum system design pressure. Do not pressurize systems above maximum design operating pressure.
6. Give seven days' advance notice for testing.

C. Duct System Cleanliness Tests:

1. Visually inspect duct system to ensure that no visible contaminants are present.
2. Test sections of metal duct system, chosen randomly by Owner, for cleanliness according to "Vacuum Test" in NADCA ACR, "Assessment, Cleaning and Restoration of HVAC Systems."

a. Acceptable Cleanliness Level: Net weight of debris collected on the filter media shall not exceed 0.75 mg/100 sq. cm.

D. Duct system will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

3.9 DUCT CLEANING

A. Clean new and existing 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.

3.10 START UP

A. Air Balance: Comply with requirements in Division 23 Section "Testing, Adjusting, and Balancing for HVAC."

3.11 DUCT SCHEDULE

A. Fabricate ducts with galvanized sheet steel except as otherwise indicated and as follows:

1. Underground Ducts: Concrete-encased, galvanized sheet steel.

B. Supply Ducts:

1. Ducts Connected to Fan Coil Units, Furnaces, Heat Pumps, and Terminal Units Insert equipment:

a. Pressure Class: Positive up to 2-inch wg.
b. Minimum SMACNA Seal Class: C.

c. SMACNA Leakage Class for Rectangular: 24.
d. SMACNA Leakage Class for Round and Flat Oval: 12.

2. Ducts Connected to Constant-Volume Air-Handling Units:

a. Pressure Class: Positive up to 6-inch wg.
b. Minimum SMACNA Seal Class: A.
c. SMACNA Leakage Class for Rectangular: 6.
d. SMACNA Leakage Class for Round and Flat Oval: 3.

3. Ducts Connected to Variable-Air-Volume Air-Handling Units:

a. Pressure Class: Positive up to 6-inch wg.
b. Minimum SMACNA Seal Class: A.
c. SMACNA Leakage Class for Rectangular: 6.
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 up to 2-inch wg.
b. Minimum SMACNA Seal Class: C.
c. SMACNA Leakage Class for Rectangular: 24.
d. SMACNA Leakage Class for Round and Flat Oval: 12.

2. Ducts Connected to Air-Handling Units:

a. Pressure Class: Positive or negative up to 6-inch wg.
b. Minimum SMACNA Seal Class: A.
c. SMACNA Leakage Class for Rectangular: 6.
d. SMACNA Leakage Class for Round and Flat Oval: 3.

D. Exhaust Ducts:

1. Ducts Connected to Fans Exhausting (ASHRAE 62.1, Class 1 and 2) Air:

a. Pressure Class: Negative up to 6-inch wg.
b. Minimum SMACNA Seal Class: A if negative pressure, and A if positive pressure.
c. SMACNA Leakage Class for Rectangular: 6.
d. SMACNA Leakage Class for Round and Flat Oval: 3.

2. Ducts Connected to Air-Handling Units:

a. Pressure Class: Positive or negative up to 6-inch wg.
b. Minimum SMACNA Seal Class: A if negative pressure, and A if positive pressure.
c. SMACNA Leakage Class for Rectangular: 6.
d. SMACNA Leakage Class for Round and Flat Oval: 3.

3. Ducts Connected to Commercial Kitchen Hoods: Comply with NFPA 96.

a. Exposed to View: Type 304, stainless-steel sheet, No. 4 finish.
b. Concealed: Type 304, stainless-steel sheet, No. 2D finish.
c. Welded seams and joints.
d. Pressure Class: Positive or negative up to 4-inch wg.

e. Minimum SMACNA Seal Class: Welded seams, joints, and penetrations.
f. SMACNA Leakage Class: 3.

4. Ducts Connected to Dishwasher Hoods:

a. Type 304, stainless-steel sheet.
b. Exposed to View: No. 4 finish.
c. Concealed: No. 2D finish.
d. Welded seams and flanged joints with watertight EPDM gaskets.
e. Pressure Class: Positive or negative up to 6-inch wg.
f. Minimum SMACNA Seal Class: Welded seams, joints, and penetrations.
g. SMACNA Leakage Class: 3.

5. Ducts Connected to Fans Exhausting Laboratory and Process (ASHRAE 62.1, Class 3 and 4) Air:

a. Type 316, stainless-steel sheet.

1) Exposed to View: No. 4 finish.
2) Concealed: No. 2B finish.

b. Pressure Class: Positive or negative up to 6-inch wg.
c. Minimum SMACNA Seal Class: Welded seams, joints, and penetrations.
d. SMACNA Leakage Class: 3.

E. Outdoor-Air (Not Filtered, Heated, or Cooled) Ducts:

1. Ducts Connected to Fan Coil Units, Furnaces, Heat Pumps, and Terminal Units:

a. Pressure Class: Positive or negative 2-inch wg.
b. Minimum SMACNA Seal Class: C.
c. SMACNA Leakage Class for Rectangular: 24.
d. SMACNA Leakage Class for Round and Flat Oval: 12.

2. Ducts Connected to Air-Handling Units:

a. Pressure Class: Positive or negative up to 3-inch wg.
b. Minimum SMACNA Seal Class: B.
c. SMACNA Leakage Class for Rectangular: 12.
d. SMACNA Leakage Class for Round and Flat Oval: 6.

3. Ducts Connected to Equipment Not Listed Above:

a. Pressure Class: Positive or negative 3-inch wg.
b. Minimum SMACNA Seal Class: B.
c. SMACNA Leakage Class for Rectangular: 12.
d. SMACNA Leakage Class for Round and Flat Oval: 6.

F. Intermediate Reinforcement:

1. Galvanized-Steel Ducts: Carbon steel coated with zinc-chromate primer.
2. Stainless-Steel Ducts:

a. Exposed to Airstream: Match duct material.
b. Not Exposed to Airstream: Match duct material.

3. Aluminum Ducts: Aluminum.

G. Liner:
1. Transfer Ducts: Fibrous glass, Type I, 1 inch thick.

H. Double-Wall Duct Interstitial Insulation:

1. Supply Air Ducts: 1 inch thick.
2. Return Air Ducts: 1 inch thick.
3. Exhaust Air Ducts: 1 inch thick.

I. Elbow Configuration:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "Rectangular Elbows."

a. Velocity 1000 fpm or Lower:

1) Radius Type RE 1 with minimum 0.5 radius-to-diameter ratio.
2) Mitered Type RE 4 without vanes.

b. Velocity 1000 to 1500 fpm:

1) Radius Type RE 1 with minimum 1.0 radius-to-diameter ratio.
2) Radius Type RE 3 with minimum 0.5 radius-to-diameter ratio and two vanes.
3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."

c. Velocity 1500 fpm or Higher:

1) Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
2) Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."

2. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "Rectangular Elbows."

a. Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
b. Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
c. Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."

3. Round Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "Round Duct Elbows."

a. Minimum Radius-to-Diameter Ratio and Elbow Segments: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 3-1, "Mitered Elbows." Elbows with less than 90-degree change of direction have proportionately fewer segments.

1) Velocity 1000 fpm or Lower: 0.5 radius-to-diameter ratio and three segments for 90-degree elbow.
2) Velocity 1000 to 1500 fpm: 1.0 radius-to-diameter ratio and four segments for 90-degree elbow.
3) Velocity 1500 fpm or Higher: 1.5 radius-to-diameter ratio and five segments for 90-degree elbow.
4) Radius-to Diameter Ratio: 1.5.

b. Round Elbows, 12 Inches and Smaller in Diameter: Stamped or pleated.
c. Round Elbows, 14 Inches and Larger in Diameter: Standing seam.

J. Branch Configuration:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-6, "Branch Connection."

a. Rectangular Main to Rectangular Branch: 45-degree entry.
b. Rectangular Main to Round Branch: Spin in.

2. Round and Flat Oval: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees." Saddle taps are permitted in existing duct.

a. Velocity 1000 fpm or Lower: 90-degree tap.
b. Velocity 1000 to 1500 fpm: Conical tap.
c. Velocity 1500 fpm or Higher: 45-degree lateral.

END OF SECTION 23 21 13

SECTION 23 33 00 - AIR DUCT ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Backdraft and pressure relief dampers.
2. Barometric relief dampers.
3. Manual volume dampers.
4. Control dampers.
5. Fire dampers.
6. Ceiling dampers.
7. Smoke dampers.
8. Combination fire and smoke dampers.
9. Corridor dampers.
10. Flange connectors.
11. Duct silencers.
12. Turning vanes.
13. Remote damper operators.
14. Duct-mounted access doors.
15. Flexible connectors.
16. Flexible ducts.
17. Duct security bars.
18. Duct accessory hardware.

B. Related Sections:

1. Division 23 Section "HVAC Gravity Ventilators" for roof-mounted ventilator caps.
2. Division 28 Section "Fire Detection and Alarm" for duct-mounted fire and smoke detectors.

1.2 SUBMITTALS

A. Product Data: For each type of product indicated.

1. For duct silencers, include pressure drop and dynamic insertion loss data. Include breakout noise calculations for high transmission loss casings.

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, smoke-damper, combination fire- and smoke-damper, ceiling, and corridor damper installations, including sleeves; and duct-mounted access doors and remote damper operators.
e. Duct security bars.
f. Wiring Diagrams: For power, signal, and control wiring.

C. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which ceiling-mounted access panels and access doors required for access to duct accessories are shown and coordinated with each other, using input from Installers of the items involved.

D. Source quality-control reports.

E. Operation and Maintenance Data: For air duct accessories to include in operation and maintenance manuals.

1.3 QUALITY ASSURANCE

A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and with NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."

B. Comply with AMCA 500-D testing for damper rating.

1.4 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. Fusible Links: Furnish quantity equal to 10 percent of amount installed.

PART 2 - PRODUCTS

2.1 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: G90.
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, 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, 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 minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.2 BACKDRAFT AND PRESSURE RELIEF DAMPERS

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

1. Greenheck Fan Corporation.
2. Nailor Industries Inc.
3. Pottorff; a division of PCI Industries, Inc.
4. Ruskin Company.

B. Description: Gravity balanced.

C. Maximum Air Velocity: 2000 fpm.

D. Maximum System Pressure: As scheduled.

E. Frame: 0.063-inch-thick extruded aluminum, with welded corners and mounting flange.

F. Blades: Multiple single-piece blades, center-pivoted, maximum 6-inch width, 0.025-inch-thick, roll-formed aluminum with sealed edges.

G. Blade Action: Parallel.

H. Blade Seals: Extruded vinyl, mechanically locked.

I. Blade Axles:

1. Material: Aluminum.
2. Diameter: 0.20 inch.

J. Tie Bars and Brackets: Aluminum.

K. Return Spring: Adjustable tension.

L. Bearings: Synthetic pivot bushings.

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 minimum.
   b. Sleeve Length: 6 inches minimum.

6. Screen Mounting: Rear mounted.

7. Screen Material: Galvanized steel.
8. Screen Type: Insect.
9. 90-degree stops.

2.3 BAROMETRIC RELIEF DAMPERS

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

1. Greenheck Fan Corporation.
2. Nailor Industries Inc.
3. Pottorff; a division of PCI Industries, Inc.
4. Ruskin Company.

B. Suitable for horizontal or vertical mounting.

C. Maximum Air Velocity: 2000 fpm.

D. Maximum System Pressure: 2-inch wg.

E. Frame: 0.063-inch-thick extruded aluminum, with welded corners and mounting flange.

F. Blades:

1. Multiple, 0.025-inch-thick, roll-formed aluminum.
2. Maximum Width: 6 inches.
3. Action: Parallel.
4. Balance: Gravity.
5. Eccentrically pivoted.

G. Blade Seals: Vinyl.

H. Blade Axles: Galvanized steel.

I. Tie Bars and Brackets:

1. Material: Aluminum.
2. Rattle free with 90-degree stop.

J. Return Spring: Adjustable tension.

K. Bearings: Synthetic.

L. Accessories:

1. Flange on intake.
2. Adjustment device to permit setting for varying differential static pressures.

2.4 MANUAL VOLUME DAMPERS

A. Standard, Steel, Manual Volume Dampers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Air Balance Inc.; a division of Mestek, Inc.
    b. Flexmaster U.S.A., Inc.
    c. McGill AirFlow LLC.
    d. METALAIRE, Inc.
    e. Nailor Industries Inc.
    f. Pottorff; a division of PCI Industries, Inc.
    g. Ruskin Company.

2. Standard leakage rating.
3. Suitable for horizontal or vertical applications.
4. Frames:

    a. Hat-shaped, galvanized-steel channels, 0.064-inch minimum thickness.
    b. Mitered and welded corners.
    c. Flanges for attaching to walls and flangeless frames for installing in ducts.

5. Blades:

    a. Multiple or single blade.
    b. Parallel- or opposed-blade design.
    c. Stiffen damper blades for stability.
    d. Galvanized-steel, 0.064 inch thick.

6. Blade Axles: Galvanized steel.
7. Bearings:

    a. Molded synthetic.
    b. Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft.

8. Tie Bars and Brackets: Galvanized steel.

B. Jackshaft:

1. Size: 1-inch diameter.
2. Material: Galvanized-steel pipe rotating within pipe-bearing assembly mounted on supports at each mullion and at each end of multiple-damper assemblies.
3. Length and Number of Mountings: As required to connect linkage of each damper in multiple-damper assembly.

C. Damper Hardware:

1. Zinc-plated, die-cast core with dial and handle made of 3/32-inch-thick zinc-plated steel, and a 3/4-inch hexagon locking nut.
2. Include center hole to suit damper operating-rod size.
3. Include elevated platform for insulated duct mounting.

2.5 CONTROL DAMPERS

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

1. Flexmaster U.S.A., Inc.
2. Greenheck Fan Corporation.
3. Lloyd Industries, Inc.
4. McGill AirFlow LLC.
5. METALAIRE, Inc.
6. Nailor Industries Inc.
7. Ruskin Company.
8. .
9. Young Regulator Company.

B. Low-leakage rating and bearing AMCA's Certified Ratings Seal for both air performance and air leakage.

C. Frames:

1. Hat or U or Angle shaped.
2. Galvanized-steel channels, 0.064 inch thick.
3. Mitered and welded corners.

D. Blades:

1. Multiple blade with maximum blade width of 8 inches.
2. Opposed-blade design.
3. Stainless steel.
4. 0.064 inch thick.

5. Blade Edging: Closed-cell neoprene edging.
6. Blade Edging: Inflatable seal blade edging, or replaceable rubber seals.

E. Blade Axles: 1/2-inch-diameter; stainless steel; 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.

F. Bearings:

1. Molded synthetic.
2. Dampers in ducts with pressure classes of 3-inch wg 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.

2.6 FIRE DAMPERS

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

1. Greenheck Fan Corporation.
2. Nailor Industries Inc.
3. Pottorff; a division of PCI Industries, Inc.
4. Ruskin Company.

B. Type: Dynamic; rated and labeled according to UL 555 by an NRTL.

C. Closing rating in ducts up to 4-inch wg static pressure class and minimum 4000-fpm velocity.

D. Frame: Curtain type with blades outside airstream; fabricated with roll-formed, 0.034-inch-thick galvanized steel; with mitered and interlocking corners.

E. Mounting Sleeve: Factory- or field-installed, galvanized sheet steel.

1. Minimum Thickness: 0.052 or 0.138 inch 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.

F. Mounting Orientation: Vertical or horizontal as indicated.

G. Blades: Roll-formed, interlocking, 0.034-inch-thick, galvanized sheet steel. In place of interlocking blades, use full-length, 0.034-inch-thick, galvanized-steel blade connectors.

H. Horizontal Dampers: Include blade lock and stainless-steel closure spring.

I. Heat-Responsive Device: Replaceable, 165 deg F rated, fusible links.

J. Heat-Responsive Device: Electric resettable link and switch package, factory installed, 165 deg F rated.

2.7 SMOKE DAMPERS

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

1. Greenheck Fan Corporation.
2. Nailor Industries Inc.
3. 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; 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.

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" and 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 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 signaling.
2. Test and reset switches, damper mounted.

2.8 COMBINATION FIRE AND 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. Greenheck Fan Corporation.
3. Nailor Industries Inc.
4. Ruskin Company.

B. Type: Dynamic; rated and labeled according to UL 555 and UL 555S by an NRTL.

C. Closing rating in ducts up to 4-inch wg static pressure class and minimum 4000-fpm velocity.

D. Frame: Curtain type with blades outside airstream; fabricated with roll-formed, 0.034-inch-thick galvanized steel; with mitered and interlocking corners.

E. Heat-Responsive Device: Replaceable, 165 deg F rated, fusible links.

F. Heat-Responsive Device: Electric resettable link and switch package, factory installed, rated.

G. Smoke Detector: Integral, factory wired for single-point connection.

H. Frame: Curtain type with blades outside airstream; fabricated with roll-formed, 0.034-inch-thick galvanized steel; with mitered and interlocking corners.

I. 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.

J. Leakage: Class I.

K. Rated pressure and velocity to exceed design airflow conditions.

L. Mounting Sleeve: Factory-installed, 0.052-inch-thick, galvanized sheet steel; length to suit wall or floor application.

M. Master control panel for use in dynamic smoke-management systems.

N. Damper Motors: two-position action.

O. 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" and 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 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.

P. Accessories:

1. Auxiliary switches for signaling.
2. Test and reset switches, damper mounted.

2.9 FLANGE CONNECTORS

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

1. Ductmate Industries, Inc.
2. Nexus PDQ; Division of Shilco Holdings Inc.
3. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
4. Lindab.
5. Other acceptable manufacturers offering equivalent products.

B. Description: roll-formed, factory-fabricated, slide-on transverse flange connectors, gaskets, and components.

C. Material: Galvanized steel.

D. Gage and Shape: Match connecting ductwork.

2.10 DUCT SILENCERS

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

1. Industrial Noise Control, Inc.
2. Ruskin Company.
3. Vibro-Acoustics
4. Industrial Acoustics

B. General Requirements:

1. Factory fabricated.
2. Fire-Performance Characteristics: Adhesives, sealants, packing materials, and accessory materials shall have flame-spread index not exceeding 25 and smoke-developed index not exceeding 50 when tested according to ASTM E 84.
3. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

C. Shape:

1. Rectangular straight with splitters or baffles.
2. Round straight with center bodies or pods.
3. Rectangular elbow with splitters or baffles.
4. Round elbow with center bodies or pods.
5. Rectangular transitional with splitters or baffles.

D. Rectangular Silencer Outer Casing: ASTM A 653/A 653M, G90, galvanized sheet steel, 0.040 inch thick.

E. Round Silencer Outer Casing: ASTM A 653/A 653M, G90, galvanized sheet steel.

1. Sheet Metal Thickness for Units up to 24 Inches in Diameter: 0.034 inch thick.
2. Sheet Metal Thickness for Units 26 through 40 Inches in Diameter: 0.040 inch thick.
3. Sheet Metal Thickness for Units 42 through 52 Inches in Diameter: 0.052 inch thick.
4. Sheet Metal Thickness for Units 54 through 60 Inches in Diameter: 0.064 inch thick.

F. Inner Casing and Baffles: ASTM A 653/A 653M, G90 galvanized sheet metal, 0.034 inch thick, and with 1/8-inch-diameter perforations.

G. Special Construction:

1. Suitable for outdoor use.
2. High transmission loss to achieve STC 45.

H. Connection Sizes: Match connecting ductwork unless otherwise indicated.

I. Principal Sound-Absorbing Mechanism:

1. Controlled impedance membranes and broadly tuned resonators without absorptive media.
2. Dissipative or Film-lined type with fill material.

a. Fill Material: Inert and vermin-proof fibrous material, packed under not less than 5 percent compression.

b. Erosion Barrier: Polymer bag enclosing fill, and heat sealed before assembly.

3. Lining: Mylar or Tedlar.

J. Fabricate silencers to form rigid units that will not pulsate, vibrate, rattle, or otherwise react to system pressure variations. Do not use mechanical fasteners for unit assemblies.

1. Lock form and seal or continuously weld joints.
2. Suspended Units: Factory-installed suspension hooks or lugs attached to frame in quantities and spaced to prevent deflection or distortion.
3. Reinforcement: Cross or trapeze angles for rigid suspension.

K. Accessories:

1. Factory-installed end caps to prevent contamination during shipping.
2. Removable splitters.
3. Airflow measuring devices.

L. Source Quality Control: Test according to ASTM E 477.

1. Record acoustic ratings, including dynamic insertion loss and generated-noise power levels with an airflow of at least 2000-fpm face velocity.
2. Leak Test: Test units for airtightness at 200 percent of associated fan static pressure or 6-inch wg static pressure, whichever is greater.

2.11 TURNING VANES

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

1. Ductmate Industries, Inc.
2. Duro Dyne Inc.
3. METALAIRE, Inc.
4. SEMCO Incorporated.
5. Other acceptable manufacturers offering equivalent products.

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 4-3, "Vanes and Vane Runners," and 4-4, "Vane Support in Elbows."

E. Vane Construction: Double wall.

F. Vane Construction: Single wall for ducts up to [48 inches] wide and double wall for larger dimensions.

2.12 REMOTE DAMPER OPERATORS

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

1. Pottorff; a division of PCI Industries, Inc.
2. Young Regulator Company.

B. Description: Cable system designed for remote manual damper adjustment.

C. Tubing: Brass.

D. Cable: Stainless steel.

E. Wall-Box Mounting: Recessed, 3/4 inches deep Surface.

F. Wall-Box Cover-Plate Material: Stainless steel.

2.13 DUCT-MOUNTED ACCESS DOORS

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

1. Flexmaster U.S.A., Inc.
2. Greenheck Fan Corporation.
3. McGill AirFlow LLC.
4. Nailor Industries Inc.
5. Pottorff; a division of PCI Industries, Inc.

B. Duct-Mounted Access Doors: Fabricate access panels according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 7-2, "Duct Access Doors and Panels," and 7-3, "Access Doors - Round Duct."

1. Door:

a. Double wall, rectangular.
b. Galvanized sheet metal with internal insulation with similar R-value or higher than specified for external ductwork insulation and thickness as indicated for duct pressure class.
c. Vision panel.
d. Hinges and Latches: 1-by-1-inch 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 Square: No hinges and two sash locks.
b. Access Doors up to 18 Inches Square: Two hinges and two sash locks.
c. Access Doors up to 24 by 48 Inches: Three hinges and two compression latches.
d. Access Doors Larger Than 24 by 48 Inches: 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: Double wall with insulation fill with metal thickness applicable for duct pressure class.
3. Operation: Open outward for positive-pressure ducts and inward for negative-pressure ducts.
4. Doors close when pressures are within set-point range.
5. Hinge: Continuous piano.
6. Latches: Cam.
7. Seal: Neoprene or foam rubber.
8. Insulation Fill: 1-inch-thick, fibrous-glass or polystyrene-foam board.

2.14 DUCT ACCESS PANEL ASSEMBLIES

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

1. Ductmate Industries, Inc.
2. Flame Gard, Inc.
3. 3M.
4. Other acceptable manufacturers offering equivalent products.

B. Labeled according to UL 1978 by an NRTL.

C. Panel and Frame: Minimum thickness 0.0528-inch carbon [0.0428-inch **stainless**] steel.

D. Fasteners: [**Carbon**] Stainless steel. Panel fasteners shall not penetrate duct wall.

E. Gasket: Comply with NFPA 96; grease-tight, high-temperature ceramic fiber, rated for minimum 2000 deg F.

F. Minimum Pressure Rating: 10-inch wg, positive or negative.

2.15 FLEXIBLE CONNECTORS

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

1. Ductmate Industries, Inc.
2. Duro Dyne Inc.
3. Ventfabrics, Inc.
4. Ward Industries, Inc.; a division of Hart & Cooley, 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 wide attached to 2 strips of 2-3/4-inch-wide, 0.028-inch-thick, galvanized sheet steel or 0.032-inch-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..

2. Tensile Strength: 480 lbf/inch in the warp and 360 lbf/inch in the filling.
3. Service Temperature: Minus 40 to plus 200 deg F.

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..
2. Tensile Strength: 530 lbf/inch in the warp and 440 lbf/inch in the filling.
3. Service Temperature: Minus 50 to plus 250 deg F.

G. High-Temperature System, Flexible Connectors: Glass fabric coated with silicone rubber.

1. Minimum Weight: 16 oz./sq. yd..
2. Tensile Strength: 285 lbf/inch in the warp and 185 lbf/inch in the filling.
3. Service Temperature: Minus 67 to plus 500 deg F.

H. 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 movement at start and stop.

2.16 FLEXIBLE DUCTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of 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; aluminized vapor-barrier film.

1. Pressure Rating: 10-inch wg positive and 1.0-inch wg negative.
2. Maximum Air Velocity: 4000 fpm.
3. Temperature Range: Minus 10 to plus 160 deg F.
4. Insulation R-value: Comply with ASHRAE/IESNA 90.1.

C. Insulated, Flexible Duct: UL 181, Class 1, black polymer film supported by helically wound, spring-steel wire; fibrous-glass insulation; aluminized vapor-barrier film.

1. Pressure Rating: 4-inch wg positive and 0.5-inch wg negative.
2. Maximum Air Velocity: 4000 fpm.

3. Temperature Range: Minus 20 to plus 175 deg F.
4. Insulation R-Value: Comply with ASHRAE/IESNA 90.1.

D. Insulated, Flexible Duct: UL 181, Class 1, aluminum laminate and polyester film with latex adhesive supported by helically wound, spring-steel wire; fibrous-glass insulation; aluminized vapor-barrier film.

1. Pressure Rating: 10-inch wg positive and 1.0-inch wg negative.
2. Maximum Air Velocity: 4000 fpm.
3. Temperature Range: Minus 20 to plus 210 deg F.
4. Insulation R-value: Comply with ASHRAE/IESNA 90.1.

E. 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, to suit duct size.

2.17 DUCT SECURITY BARS

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

1. Carnes.
2. KEES, Inc.
3. Lloyd Industries, Inc.
4. Metal Form Manufacturing, Inc.

B. Description: Field- or factory-fabricated and field-installed duct security bars.

C. Configuration:

1. Frame: 10 gage by 2 inches.
2. Sleeve: 3/16-inch, continuously welded steel frames with 1-by-1-by-3/16-inch angle frame factory welded to 1 end. To be poured in place or set with concrete block or welded or bolted to wall, one side only. Duct connections on both sides.
3. Horizontal Bars: 1/2 inch.
4. Vertical Bars: 1/2 inch.
5. Bar Spacing: 6 inches.

2.18 DUCT ACCESSORY HARDWARE

A. Instrument Test Holes: Cast iron or cast aluminum to suit duct material, including screw cap and gasket. Size to allow insertion of pitot tube and other testing instruments and of length to suit duct-insulation thickness.

B. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts and in NAIMA AH116, "Fibrous Glass Duct Construction Standards," for fibrous-glass ducts.

B. Install duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel and fibrous-glass ducts, stainless-steel accessories in stainless-steel ducts, and aluminum accessories in aluminum ducts.

C. Install backdraft dampers at inlet of exhaust fans or exhaust ducts as close as possible to exhaust fan unless otherwise indicated.

D. Install volume dampers at points on supply, return, and exhaust systems where branches extend from larger ducts. Where dampers are installed in ducts having duct liner, install dampers with hat channels of same depth as liner, and terminate liner with nosing at hat channel.

1. Install steel volume dampers in steel ducts.
2. Install aluminum volume dampers in aluminum ducts.

E. Set dampers to fully open position before testing, adjusting, and balancing.

F. Install test holes at fan inlets and outlets and elsewhere as indicated.

G. Install fire and smoke dampers according to UL listing.

H. Install duct security bars. Construct duct security bars from 0.164-inch steel sleeve, continuously welded at all joints and 1/2-inch-diameter steel bars, 6 inches o.c. in each direction in center of sleeve. Weld each bar to steel sleeve and each crossing bar. Weld 2-1/2-by-2-1/2-by-1/4-inch steel angle to 4 sides and both ends of sleeve. Connect duct security bars to ducts with flexible connections. Provide 12-by-12-inch hinged access panel with cam lock in duct in each side of sleeve.

I. Connect ducts to duct silencers rigidly.

J. 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 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 spacing.
8. Upstream from turning vanes.
9. Upstream or downstream from duct silencers.
10. Control devices requiring inspection.
11. Elsewhere as indicated.

K. Install access doors with swing against duct static pressure.

L. Access Door Sizes:

1. One-Hand or Inspection Access: 8 by 5 inches.
2. Two-Hand Access: 12 by 6 inches.
3. Head and Hand Access: 18 by 10 inches.
4. Head and Shoulders Access: 21 by 14 inches.
5. Body Access: 25 by 14 inches.
6. Body plus Ladder Access: 25 by 17 inches.

M. Label access doors according to Division 23 Section "Identification for HVAC Piping and Equipment" to indicate the purpose of access door.

N. Install flexible connectors to connect ducts to equipment.

O. For fans developing static pressures of 5-inch wg and more, cover flexible connectors with loaded vinyl sheet held in place with metal straps.

P. Connect terminal units to supply ducts with maximum 12-inch lengths of flexible duct. Do not use flexible ducts to change directions.

Q. Connect flexible ducts to metal ducts with adhesive plus sheet metal screws.

R. Install duct test holes where required for testing and balancing purposes.

S. 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 movement during start and stop of fans.

3.2 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. Operate dampers to verify full range of movement.
2. Inspect locations of access doors and verify that purpose of access door can be performed.
3. Operate fire, smoke, and combination 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.
5. Operate remote damper operators to verify full range of movement of operator and damper.

END OF SECTION 23 33 00

SECTION 23 37 13 - DIFFUSERS, REGISTERS, AND GRILLES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Rectangular and square ceiling diffusers.
2. Perforated diffusers.
3. Louver face diffusers.
4. Linear bar diffusers.
5. Linear slot diffusers.
6. Ceiling-integral continuous diffusers.
7. Continuous tubular diffusers.
8. Adjustable bar registers and grilles.
9. Fixed face registers and grilles.
10. Linear bar grilles.

B. Related Sections:

1. Division 08 Section "Louvers and Vents" for fixed and adjustable louvers and wall vents, whether or not they are connected to ducts.
2. Division 23 Section "Air Duct Accessories" for fire and smoke dampers and volume-control dampers not integral to diffusers, registers, and grilles.

1.2 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.

PART 2 - PRODUCTS

2.1 CEILING DIFFUSERS

A. Rectangular and Square Ceiling Diffusers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. METALAIRE, Inc.
b. Nailor Industries Inc.
c. Krueger.
d. Titus.
e. Price.

2. Devices shall be specifically designed for variable-air-volume flows.
3. Material: Refer to schedules.
4. Finish: Refer to schedules.
5. Face Size: Refer to schedule.
6. Face Style: Three cone.
7. Mounting: Refer to schedule.
8. Pattern: Refer to schedules

B. Perforated Diffuser:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. METALAIRE, Inc.
   b. Nailor Industries Inc.
   c. Krueger.
   d. Titus.
   e. Price.

2. Devices shall be specifically designed for variable-air-volume flows.
3. Material: Refer to schedule.
4. Finish: Refer to schedules.
5. Face Size: Refer to schedule.
6. Mounting: Refer to schedule.

2.2 CEILING LINEAR SLOT OUTLETS

A. Linear Bar Diffuser:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. METALAIRE, Inc.
   b. Nailor Industries Inc.
   c. Krueger.
   d. Titus.
   e. Price.

2. Devices shall be specifically designed for variable-air-volume flows.
3. Material: Aluminum.
4. Finish: Baked enamel, white.
5. Two-Way Deflection Vanes: Extruded construction fixed louvers with removable core.

B. Linear Slot Diffuser:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. METALAIRE, Inc.
   b. Nailor Industries Inc.
   c. Krueger.
   d. Titus.
   e. Price.

2. Devices shall be specifically designed for variable-air-volume flows.
3. Material - Shell: Aluminum,.
4. Material - Pattern Controller and Tees: Aluminum.
5. Finish - Face and Shell: Baked enamel, black.
6. Finish - Pattern Controller: Baked enamel, black.
7. Finish - Tees: Baked enamel, white.
8. Slot Width: Refer to Schedule.
9. Number of Slots: Refer to schedule.
10. Length: Refer to schedule.

C. Ceiling-Integral Continuous Diffuser:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. METALAIRE, Inc.
   b. Nailor Industries Inc.
   c. Krueger.
   d. Titus.
   e. Price.

2. Slot Width: Refer to schedule.
3. Section Length: Refer to schedule.
4. Straight and curved sections as required to accommodate layout.
5. Mitered tees and corners.
6. Pattern Controllers: Refer to schedule.
7. Material: Aluminum, extruded, heavy wall.
8. Finishes:

   a. Exterior: Standard white.
   b. Interior: Standard black.

9. Throw: Standard.
10. Mounting: Refer to schedule.
11. Plenum: Insulated.
12. Other Features:

    a. Painted interior.
    b. Blank-offs.

2.3 REGISTERS AND GRILLES

A. Adjustable Bar Register:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. METALAIRE, Inc.
   b. Nailor Industries Inc.
   c. Krueger.
   d. Titus.
   e. Price.

2. Material: Refer to schedules.

3. Finish: Refer to schedule.
4. Frame: Refer to schedule

B. Adjustable Bar 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 or comparable product by one of the following:

   a. METALAIRE, Inc.
   b. Nailor Industries Inc.
   c. Krueger.
   d. Titus.
   e. Price.

3. Material: Refer to schedule.
4. Finish: Refer to schedule.
5. Face Blade Arrangement: Refer to schedule. **(13 mm)**
6. Frame: Refer to schedule.

C. Fixed Face Register:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. METALAIRE, Inc.
   b. Nailor Industries Inc.
   c. Krueger.
   d. Titus.
   e. Price.

2. Material: Refer to schedule.
3. Finish: Refer to schedule.
4. Face Arrangement: Perforated core.
5. Core Construction: Refer to schedule.
6. Frame: Refer to Schedule.
7. Mounting Frame: Refer to schedule.
8. Mounting: Refer to schedule.

D. 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 or comparable product by one of the following:

   a. METALAIRE, Inc.
   b. Nailor Industries Inc.
   c. Krueger.
   d. Titus.
   e. Price.

3. Material: Refer to schedule.
4. Finish: Refer to schedule.

5. Face Arrangement: Refer to schedules.
6. Core Construction: Refer to schedules.
7. Frame: Refer to specifications.
8. Mounting Frame: Refer to schedules.
9. Mounting: Refer to schedules.
10. Accessory: Filter. (Re: Schedule)

E. Linear Bar Grille:

1. Basis-of-Design Product: Subject to compliance with requirements, provide or comparable product by one of the following:

   a. METALAIRE, Inc.
   b. Nailor Industries Inc.
   c. Krueger.
   d. Titus.
   e. Price.

2. Material: Refer to schedules.
3. Finish: Refer to schedules.
4. Face Arrangement: Refer to schedules.
5. Distribution plenum.

   a. Internal insulation.
   b. Inlet damper.

6. Frame: Refer to schedules.
7. Mounting Frame: Refer to schedules.
8. Mounting: Refer to schedules.

2.4 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

3.1 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.

3.2 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 loca-

tions 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.

3.3 ADJUSTING

A. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.

END OF SECTION 23 37 13

SECTION 23 74 33 - DEDICATED OUTDOOR -AIR UNITS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes factory-packaged units capable of supplying up to 100 percent outdoor air and providing cooling and heating.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product. Include rated capacities, operating characteristics, and furnished specialties and accessories.

B. Shop Drawings:

1. Include plans, elevations, sections, and attachment details.
2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Prepare the following:
   a. Include diagrams for power, signal, and control wiring.

C. Delegated-Design Submittal: For design of vibration isolation and wind restraints, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1. Unit fabrication and assembly details.
2. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.

1.3 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Roof-curb mounting details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Size and location of unit-mounted rails and anchor points and methods for anchoring units to roof curb.
2. Required roof penetrations for ducts, pipes, and electrical raceways, BAS sensors including size and location of each penetration.

B. Startup service reports.

C. Sample Warranty: For special warranty.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For units to include in emergency, operation, and maintenance manuals.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1.
2. Filters: One set for each unit.

1.6 WARRANTY

A. Special Warranty: Manufacturer agrees to replace components of units that fail in materials or workmanship within specified warranty period.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

1. Trane
2. Carrier
3. Valent
4. Daikin
5. Engineered Air
6. York

2.2 PERFORMANCE REQUIREMENTS

A. General Fabrication Requirements: Comply with requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment," and Section 7 - "Construction and System Start-up."

B. Delegated Design: Engage a qualified professional engineer, as defined in Division 01 Section "Quality Requirements," to design vibration isolation and wind restraints.

C. Cabinet Thermal Performance:

1. Maximum Overall U-Value: Comply with requirements in ASHRAE/IESNA 90.1.
2. Include effects of metal-to-metal contact and thermal bridges in the calculations.

D. Cabinet Surface Condensation:

1. Cabinet shall have additional insulation and vapor seals if required to prevent condensation on the interior and exterior of the cabinet.
2. Portions of cabinet located downstream from the cooling coil shall have a thermal break at each thermal bridge between the exterior and interior casing to prevent condensation

from occurring on the interior and exterior surfaces. The thermal break shall not compromise the structural integrity of the cabinet.

E. Maximum Cabinet Leakage: 2 percent of the total supply-air flow at a pressure rating equal to the fan shut-off pressure.

F. Cabinet Deflection Performance:

1. Walls and roof deflection shall be within 1/200 of the span at the design working pressure equal to the fan shut-off pressure. Deflection limits shall be measured at any point on the surface.
2. Floor deflections shall be within 1/240 of the span considering the worst-case condition caused by the following:

   a. Service personnel.
   b. Internal components.
   c. Design working pressure defined for the walls and roof.

G. Electrical components, devices, and accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.3 CABINET

A. Construction: double wall. Provide factory insulated casing sections with expanded foam or non-compressed fiberglass (three pounds per cubit foot density) insulation with a minimum R-value of 12.

B. Exterior Casing Material: Minimum 16 gage G90 Galvanized steel with paint finish.

C. Interior Casing Material: Minimal 20 gage G90 Galvanized steel.

D. A 20-gage galvanized sheet shall enclose the insulation on the bottom of the unit.

E. Unit floor shall be 14-gage, galvanized threat plate insulated with R-12 insulation.

F. Lifting and Handling Provisions: Factory-installed shipping skids and lifting lugs.

G. Access for Inspection, Cleaning, and Maintenance: Comply with requirements in ASHRAE 62.1.

1. Service Doors: Hinged access doors with gaskets. Material and construction of doors shall match material and construction of cabinet in which doors are installed.

H. Floor: Reinforced, metal surface; reinforced to limit deflection when walked on by service personnel. Insulation shall be below metal walking surface.

I. VFD Enclosure: AHU shall include an enclosure for fan VFD. Enclosure shall be provided and installed by the AHU's manufacturer. The enclosure shall be recessed or surface mounted. The VFD enclosure shall include conditioned air from the main AHU fan, including, but not limited to air volume damper as required by the AHU manufacturer. The enclosure shall be internally insulated to prevent exterior condensation.

J. Condensate Drain Pans:

1. Shape: Rectangular, with 2 percent slope in at least two planes to direct water toward drain connection.
2. Size: Large enough to collect condensate from cooling coils including coil piping connections, coil headers, and return bends.

    a. Length: Extend drain pan downstream from leaving face to comply with ASHRAE 62.1.
    b. Depth: A minimum of 2 inches deep.

3. Configuration: Single wall, with foam insulation under the pan and moisture-tight seal.
4. Material: 306 Stainless-steel sheet.
5. Drain Connection:

    a. Located on one end of pan, at lowest point of pan.
    b. Terminated with threaded nipple.
    c. Minimum Connection Size: NPS 2.

6. Units with stacked coils shall have an intermediate drain pan to collect condensate from top coil.

K. Surfaces in Contact with Airstream: Comply with requirements in ASHRAE 62.1 for resistance to mold and erosion.

2.4 SUPPLY FAN

A. Forward-Curved Fan Type: Centrifugal; statically and dynamically balanced.

1. Fan Wheel Material: Galvanized Coated steel, mounted on solid-steel shaft.
2. Bearings: Pillow-block bearings rated L_{50} for 200,000 hours and having external grease fittings.

B. Motors:

1. Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Division 23 Section "Common Motor Requirements for HVAC Equipment."
2. Enclosure: Open dripproof.
3. Enclosure Materials: Cast iron.
4. Efficiency: Premium efficient.
5. Service Factor: 1.15.

C. Mounting: Fan wheel, motor, and drives shall be mounted to fan casing with restrained spring isolators.

2.5 COOLING COILS

1. Maximum Face Velocity: 450 fpm (m/s).
2. Coil Type: Continuous circuit.
3. Piping Connections: Threaded, same end of coil.
4. Tube Material: Copper.
5. Tube Diameter: 1/2 inch or 5/8 inch
6. Tube Thickness: Return U-bends shall have a minimum wall thickness of 0.032” for 1/2” tubes (0.035” for 5/8” tubes) and shall be brazed to tubes. Coils constructed by bending

tubes, instead of having brazed u-bends, shall not be acceptable since bending the tubes will reduce the wall thickness on the outer side of the bend and would compromise the coil quality. (mm)

7. Fin Type: Plate.
8. Fin Material: Aluminum.
9. Fin Spacing: Maximum of 12 fins/in.
10. Fin Thickness: 0.006 inches (mm).
11. Fin and Tube Joint: Mechanical bond.
12. Headers: Seamless copper tube with brazed joints.
13. Headers shall be enclosed within the AHU casing.
14. Connection: Steel MPT
15. Frames: Channel frame, 0.064-inch- (1.6-mm-) thick (16 Gauge) stainless steel.
16. Coil Working-Pressure Ratings: 250 psig (1380 kPa), 300 deg F (163 deg C).
17. Coating: None.

2.6 ENERGY RECOVERY WHEEL

1. Coil Type: Continuous circuit.
2. Piping Connections: Threaded, same end of coil.
3. Tube Material: Copper.
4. Tube Diameter: 1/2 inch or 5/8 inch
5. Tube Thickness: Return U-bends shall have a minimum wall thickness of 0.032” for 1/2” tubes (0.035” for 5/8” tubes) and shall be brazed to tubes. Coils constructed by bending tubes, instead of having brazed u-bends, shall not be acceptable since bending the tubes will reduce the wall thickness on the outer side of the bend and would compromise the coil quality.
6. Fin Type: Plate .
7. Fin Material: Aluminum.
8. Fin Spacing: Maximum of 12 fins/in.
9. Fin Thickness: 0.006 - inch.
10. Fin and Tube Joint: Mechanical bond.
11. Headers:

    a. Seamless copper tube with brazed joints.
    b. Headers shall be enclosed within the AHU casing.

12. Connection: Steel MPT
13. Frames: Channel frame, 0.064-inch-thick (16 Gauge) stainless steel.
14. Coil Working-Pressure Ratings: 250 psig, 300 deg F.
15. Coating: None.

2.7 OUTDOOR-AIR INTAKE HOOD

A. Type: Manufacturer's standard hood or louver.

B. Materials: Match cabinet.

C. Bird Screen: Comply with requirements in ASHRAE 62.1.

D. Configuration: Designed to inhibit wind-driven rain and snow from entering unit.

2.8 AIR FILTRATION SECTION

A. General Requirements for Air Filtration Section:

1. Comply with NFPA 90A.
2. Provide minimum arrestance according to ASHRAE 52.1, and a minimum efficiency reporting value (MERV) according to ASHRAE 52.2.
3. Provide “Front-Loading” framing modules for both pre-filter (MERV 7) and final (MERV 11) filters. Filter tracks shall be permanently gasketed to eliminated bypass. The prefilter track shall be separated to allow removal and insertion of pre-filters without disturbing the final filters. Each filter framing shall include factory-installed positive sealing bars to permit easy change-out of filters. Gaskets on filters must be compressed during operation.

B. Extended-Surface, Disposable Panel Filters:

1. Factory-fabricated, dry, extended-surface type.
2. Thickness: 2 inches.
3. MERV 7
4. Media: Fibrous material formed into deep-V-shaped pleats with antimicrobial agent and held by self-supporting wire grid.
5. Media-Grid Frame: Nonflammable cardboard.
6. Filter Tracks: Side loading filter tracks shall be constructed of galvanized steel and be built as an integral part of the unit. .

C. Extended-Surface, High and Medium Efficiency Mini-pleat Filters:

1. Factory-fabricated
2. Thickness: 4 inches
3. MERV 11
4. Media: Microglass paper with a water resistant binder. Fibers shall be formed with dual density construction, consisting of coarser air fibers on the air entering side and finer fibers on the air leaving side; allowing particles to be collected throughout the full thickness of the media to increase dust holding capacity

2.9 ELECTRICAL POWER CONNECTIONS

A. General Electrical Power Connection Requirements: Factory-installed and -wired switches, motor controllers, transformers, and other necessary electrical devices shall provide a single-point field power connection to unit.

B. Enclosure: NEMA 250, Type 4, mounted in unit with hinged access door in unit cabinet having a lock and key or padlock and key,

C. Wiring: Numbered and color-coded to match wiring diagram.

D. Wiring Location: Install factory wiring outside an enclosure in a raceway.

E. Factory Wiring: Branch power circuit to each motor and to controls with one of the following disconnecting means:

1. NEMA KS 1, heavy-duty, nonfusible switch.

F. Controls: Factory wire unit-mounted controls where indicated.

G. Lights: Factory wire unit-mounted lights.

2.10 CASING INTEGRITY

A. No field penetrations of the air handler casing are permitted.

B. All penetrations required to accomplish testing, balancing, to provide power to internal devices, and to provide control signal to and from control devices shall be made and sealed at the factory.

C. Coordinate with the manufacturer to allow for all necessary penetrations to provide a complete, functioning and maintainable system. Internal control devices shall be shipped to the air handling unit manufacturer for installation at no cost to the owner.

2.11 DAMPERS

1. General Requirements for Dampers: Leakage rate, according to AMCA 500, "Laboratory Methods for Testing Dampers for Rating," shall not exceed 2 percent of air quantity at 2000-fpm face velocity through damper and 4-inch wg pressure differential.
2. Outdoor- Air Dampers: Low-leakage, double-skin, extruded aluminum airfoil-blade, aluminum dampers with compressible jamb seals and ruskiprene blade edge seals in parallel-blade arrangement with cadmium-plated steel operating rods rotating in sintered bronze or nylon or molded synthetic bearings mounted in a single aluminum frame, and with operating rods connected with a common linkage. Leakage rate shall not exceed 3 cfm/sq. ft. at 1-inch wg and 8 cfm/sq. ft. at 4-inch wg.
3. Provide a smoke damper at the discharge opening of the air handling unit supply air opening. Damper motor shall be installed inside the AHU. AHU and BAS vendor shall coordinate fan shutdown when damper is commanded closed with appropriated time delay to avoid unit damage. Refer to spec. 233300 for smoke damper details.

2.12 ACCESSORIES

A. Service Lights and Switch: Factory installed in each accessible section with weatherproof cover. Factory wire lights to a single-point field connection.

PART 3 - EXECUTION

3.1 EXAMINATION

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

B. Examine roughing-in for piping, ducts, and electrical systems to verify actual locations of connections before equipment installation.

C. Examine roof curbs and equipment supports for suitable conditions where units will be installed.

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

3.2 INSTALLATION

A. Comply with manufacturer's rigging and installation instructions for unloading units and moving to final locations.

B. Install separate devices furnished by manufacturer and not factory installed.

C. Install new filters at completion of equipment installation and before testing, adjusting, and balancing.

D. Install drain pipes from unit drain pans.

1. Drain Piping: Drawn-temper copper water tubing complying with ASTM B 88, Type L, with soldered joints.
2. Pipe Size: Same size as condensate drain pan connection.

3.3 CONNECTIONS

A. Where installing piping adjacent to units, allow space for service and maintenance.

B. Hydronic Piping Connections:

1. Comply with requirements in Division 23 Section "Hydronic Piping."
2. Install shutoff valve and union or flange on each supply connection and install balancing valve and union or flange on each return connection.

C. Duct Connections:

1. Comply with requirements in Division 23 Section "Metal Ducts."
2. Drawings indicate the general arrangement of ducts.
3. Connect ducts to units with flexible duct connectors. Comply with requirements for flexible duct connectors in Division 23 Section "Air Duct Accessories."

D. Electrical Connections: Comply with requirements for power wiring, switches, and motor controls in Division 26 Sections.

1. Install electrical devices furnished by unit manufacturer but not factory mounted.

3.4 STARTUP SERVICE

A. Perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.
2. Inspect units for visible damage.
3. Inspect casing insulation for integrity, moisture content, and adhesion.
4. Verify that clearances have been provided for servicing.
5. Verify that controls are connected and operable.
6. Verify that filters are installed.
7. Clean coils and inspect for construction debris.
8. Inspect and adjust vibration isolators.
9. Verify bearing lubrication.
10. Clean fans and inspect fan-wheel rotation for movement in correct direction without vibration and binding.
11. Adjust fan belts to proper alignment and tension.
12. Start unit.

13. Inspect and record performance of interlocks and protective devices including response to smoke detectors by fan controls and fire alarm.
14. Operate unit for run-in period.
15. Calibrate controls.
16. Adjust and inspect high-temperature limits.
17. Inspect outdoor-air dampers for proper stroke.
18. Verify operational sequence of controls.
19. Measure and record the following airflows. Plot fan volumes on fan curve.

    a. Supply-air volume.
    b. Outdoor-air flow.

B. After startup, change filters, verify bearing lubrication, and adjust belt tension.

C. Remove and replace components that do not properly operate and repeat startup procedures as specified above.

D. Prepare written report of the results of startup services.

3.5 ADJUSTING

A. Adjust initial temperature and humidity set points.

B. Set field-adjustable switches and circuit-breaker trip ranges as indicated.

C. Occupancy Adjustments: When requested within 12 months from date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

3.6 DEMONSTRATION

A. Contractor to train Owner's maintenance personnel to adjust, operate, and maintain units.

END OF SECTION 23 74 33

SECTION 23 81 46 - WATER-SOURCE UNITARY HEAT PUMPS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following types of water-source heat pumps:

1. Concealed horizontal or vertical units, 6 tons and smaller.

1.2 SUBMITTALS

A. Product Data: Include rated capacities, furnished specialties, and accessories for each model.

1. Wiring Diagrams: Power, signal, and control wiring.

B. Coordination Drawings: Floor plans, 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. Suspended ceiling components.
2. Structural members to which heat pumps will be attached.
3. Method of attaching hangers to building structure.
4. Size and location of initial access modules for acoustical tile.
5. Items penetrating finished ceiling, including the following:

a. Lighting fixtures.
b. Air outlets and inlets.
c. Speakers.
d. Sprinklers.
e. Access panels.

C. Samples for Initial Selection: For units with factory-applied color finishes.

D. Samples for Verification: For each type of unit indicated.

E. Product Certificates: For each type of water-source heat pump, signed by product manufacturer.

F. Manufacturer Seismic Qualification Certification: Submit certification that water-source heat pumps, accessories, and components will withstand seismic forces defined in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment." 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.

G. Field quality-control test reports.

H. Operation and Maintenance Data: For water-source heat pumps to include in emergency, operation, and maintenance manuals.

I. Warranty: Special warranty specified in this Section.

1.3 QUALITY ASSURANCE

A. Product Options: Drawings indicate size, profiles, and dimensional requirements of water-source heat pumps and are based on the specific system indicated. Refer to Division 01 Section "Product Requirements."

1. Do not modify intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If modifications are proposed, submit comprehensive explanatory data to Architect for review.

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:

1. ASHRAE 15.
2. 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."

E. Comply with NFPA 70.

F. Comply with safety requirements in UL 484 for assembly of free-delivery water-source heat pumps.

G. Comply with safety requirements in UL 1995 for duct-system connections.

1.4 COORDINATION

A. Coordinate layout and installation of water-source heat pumps and suspension components with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system components, and partition assemblies.

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."

1.5 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of water-source heat pumps that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, refrigeration components.
2. Warranty Period: **Five**years from date of Substantial Completion.

1.6 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. **One** set(s) of filters for each unit.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.
2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 CONCEALED WATER-SOURCE HEAT PUMPS, 6 TONS AND SMALLER

A. **Available** Manufacturers:
1.
2. Carrier Corporation.
3. ClimateMaster, Inc.
4. York
5. Bosch/FHPDiakin.
6. Trane.
7. Water Furnace International, Inc.

B. Description: Packaged water-source heat pump with temperature controls; factory assembled, tested, and rated according to ARI-ISO-13256-1.

C. Cabinet and Chassis: Galvanized-steel casing with the following features:

1. Access panel for access and maintenance of internal components.
2. Knockouts for electrical and piping connections.
3. Flanged duct connections.
4. Cabinet Insulation: Glass-fiber liner, minimum 1/2 inch thick, complying with UL 181.
5. Condensate Drainage: Plastic or stainless-steel drain pan with condensate drain piping projecting through unit cabine**t and complying with ASHRAE 62.1-2004**].
6. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1-2004.
7. Sound Attenuation Package:

    a. Minimum 0.598-inch-thick compressor enclosure and front panel. Minimum 0.0937-inch-thick foam gasket around the compressor and perimeter of end panel.
    b. Sound attenuating blanket over compressor.
    c. Hot-gas muffler.

D. Fan: Direct driven, centrifugal, with multispeed motor resiliently mounted in fan inlet.

1. General requirements for motors are specified in Division 23 Section "Common Motor Requirements for HVAC Equipment."
2. Motor: Multispeed, permanently lubricated, **ECM** motor.

E. Water Circuit:

1. Refrigerant-to-Water Heat Exchangers:

    a. Coaxial heat exchangers with [**copper**] water tube with enhanced heat-transfer surfaces inside a steel shell; both shell and tube leak tested to 450 psig on refrigerant side and 400 psig on water side. Factory mount heat exchanger in unit on resilient rubber vibration isolators.
    b. Stainless-steel, brazed-plate heat exchanger leak tested to 450 psig for refrigerant side and 400 psig for water side. Factory mount heat exchanger in unit on resilient rubber vibration isolators.

F. Refrigerant-to-Air Coils: Copper tubes with aluminum fins, leak tested to 450 psig.

1. Sealed Refrigerant Circuit: Charge with **R-410A** refrigerant.
2. Filter-Dryer: Factory installed to clean and dehydrate the refrigerant circuit.
3. Charging Connections: Service fittings on suction and liquid for charging and testing.
4. Reversing Valve: Pilot-operated sliding-type valve designed to be fail-safe in heating position with replaceable magnetic coil.
5. Compressor: Hermetic [**scroll**] compressor installed on vibration isolators and housed in an acoustically treated enclosure with factory-installed safeties as follows:

    a. Antirecycle timer.
    b. High-pressure cutout.
    c. Low-pressure cutout or loss of charge switch.
    d. Internal thermal-overload protection.
    e. Freezestat to stop compressor if water-loop temperature in refrigerant-to-water heat exchanger falls below **32 deg F**.
    f. Condensate overflow switch to stop compressor with high condensate level in condensate drain pan.

6. Refrigerant Piping Materials: ASTM B 743 copper tube with wrought-copper fittings and brazed joints.

7. Pipe Insulation: Refrigerant minimum 3/8-inch-thick, flexible elastomeric insulation on piping exposed to airflow through the unit. Maximum 25/50 flame-spread/smoke-development indexes according to ASTM E 84.
8. Refrigerant Metering Device: Thermal expansion valve to allow specified operation with entering-water temperatures from **40 to 110 deg F**

G. Filters: Disposable, pleated, [**1 inch**] thick, and having a minimum of 80 percent arrestance according to ASHRAE 52.1 and a minimum efficiency reporting value of 8 according to ASHRAE 52.2.

H. Control equipment and sequence of operation are specified in Division 23 Sections "Instrumentation and Controls for HVAC" and "Sequence of Operations for HVAC Controls."

I. Controls:

1. Basic Unit Controls:

   a. Low- and high-voltage protection.
   b. Overcurrent protection for compressor and fan motor.
   c. Random time delay, three to ten seconds, start on power up.
   d. Time delay override for servicing.
   e. Control voltage transformer.

2. Thermostat:

   a. Wall-Mounted Thermostat:

      1) Heat-cool-off switch.
      2) Fan on-auto switch.
      3) [**Automatic**] changeover.
      4) [**Exposed**] temperature set point.
      5) [**Exposed**] temperature indication.
      6) Deg [**F**] [**C**] indication.

3. Terminal Controller:

   a. Scheduled operation for occupied and unoccupied periods on [**7**] [**365**]-day clock with minimum 4 programmable periods per day.
   b. **Two** hour unoccupied period override period.
   c. Remote control panel to contain programmable timer and LED for fault condition.
   d. Compressor disable relay to stop compressor operation for demand limiting or switch to unoccupied operation.
   e. Automatic restart after five minutes if fault clears. Lockout after three attempts to restart following fault. Indicate fault for service technician.
   f. Return-air temperature high-limit (firestat). Stop unit on high temperature.
   g. Backup for volatile memory.
   h. Differential pressure switch to indicate fan status. Fan failure alarm.
   i. Differential pressure switch to indicate filter status. Dirty filter alarm.

4. BAS interface requirements as further described in Division 23 Sections "Instrumentation and Controls for HVAC" and "Sequence of Operations for HVAC Controls."

   a. Interface relay for scheduled operation.
   b. Interface relay to provide indication of fault at central workstation.
   c. Provide [**BAC-net**] interface for central BAS workstation for the following functions:

1) Set-point adjustment for set points identified in this Section.
2) Start/stop and operating status of heat-pump unit.
3) Data inquiry to include supply air, room air temperature and humidity, and entering-water temperature.
4) Occupied and unoccupied schedules.

J. Electrical Connection: Single electrical connection[**with fused disconnect**].

K. Capacities and Characteristics:
a. Maximum Face Velocity: **<400.>**

2. Electrical Characteristics for Single Connection:

a. Volts/Phase/Hertz: 208/1/60; 460/3/60 on ERU

2.3 PUMPS

A. Minimum **1/6-hp** 230-V, single-phase pump rated to move at least **16 gpm**< at 40 ft head pressure.

1. General requirements for motors are specified in Division 23 Section "Common Motor Requirements for HVAC Equipment."

B. Include pump hose kit with thread to barb fittings, hose, and hose clamps.

C. Include controls to operate pump as required to maintain room temperature and ventilation set points.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of water-source heat pumps.

B. Examine roughing-in for piping and electric installations for water-source heat pumps to verify actual locations of piping connections and electrical conduit before installation.

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

3.2 INSTALLATION

A. Concrete Bases: Install floor mounting units on 4-inch-high concrete bases. See Division 23 Section "Common Work Results for HVAC" for concrete base materials and fabrication requirements.

B. Mount water-source heat pumps on concrete base with vibration isolators[and seismic restraints].[Vibration isolators are specified in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."]

1. Units with Internally Isolated Fans and Compressors: Support on concrete bases using neoprene pads with minimum 0.125-inch static deflection. Secure units to anchor bolts installed in concrete bases.

C. Suspend water-source heat pumps from structure with threaded steel rods and minimum **0.25-inch** static deflection rubber-in-shear vibration isolators. Vibration isolators are specified in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."

D. Unit ERU Support: Install unit level on structural Pad. Coordinate wall penetrations and flashing with wall construction

E. in Division 23 Section "Instrumentation and Control for HVAC."

3.3 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties. Specific connection requirements are as follows:

1. Connect supply and return hydronic piping to heat pump with [**unions and shutoff valves**] [**hose kits**].
2. Connect heat-pump condensate drain pan to indirect waste connection with condensate trap of adequate depth to seal against the pressure of fan. Install cleanouts in piping at changes of direction.

B. Duct installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of ducts. Specific connection requirements are as follows:

1. Connect supply and return ducts to water-source heat pumps with flexible duct connectors specified in Division 23 Section "Air Duct Accessories."

C. Install electrical devices furnished by manufacturer but not specified to be factory mounted.

D. Install piping adjacent to machine to allow service and maintenance. Ground any metal piping components to the unit ground.

E. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

F. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.4 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. After installing water-source heat pumps and after electrical circuitry has been energized, test units for compliance with requirements.
2. Inspect for and remove shipping bolts, blocks, and tie-down straps.

3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

C. Remove and replace malfunctioning units and retest as specified above.

3.5 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

B. Complete installation and startup checks according to manufacturer's written instructions and do the following:

1. Inspect for visible damage to unit casing.
2. Inspect for visible damage to compressor, coils, and fans.
3. Inspect internal insulation.
4. Verify that labels are clearly visible.
5. Verify that clearances have been provided for servicing.
6. Verify that controls are connected and operable.
7. Verify that filters are installed.
8. Adjust vibration isolators.
9. Inspect operation of barometric dampers.
10. Verify bearing lubrication on fan.
11. Inspect fan-wheel rotation for movement in correct direction without vibration and binding.
12. Adjust fan belts to proper alignment and tension.
13. Start unit according to manufacturer's written instructions.
14. Complete startup sheets and attach copy with Contractor's startup report.
15. Inspect and record performance of interlocks and protective devices; verify sequences.
16. Operate unit for an initial period as recommended or required by manufacturer.
17. Verify thermostat and humidistat calibration.
18. Inspect outdoor-air dampers for proper stroke and interlock with return-air dampers.
19. Inspect controls for correct sequencing of heating, mixing dampers, refrigeration, and normal and emergency shutdown.
20. Start refrigeration system and measure and record the following:

    a. Coil leaving-air, dry- and wet-bulb temperatures.
    b. Coil entering-air, dry- and wet-bulb temperatures.
    c. Entering water temperature.
    d. Leaving water temperature.
    e. Water Flow rate

21. Measure and record the following minimum and maximum airflows. Plot fan volumes on fan curve.

    a. Supply-air volume.
    b. Return-air volume.

3.6 ADJUSTING

A. Adjust initial temperature and humidity set points.

B. Set field-adjustable switches and circuit-breaker trip ranges as indicated.

C. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to [**two**] <**Insert number**> visits to Project during other than normal occupancy hours for this purpose.

3.7 CLEANING

A. Replace filters used during construction prior to air balance or substantial completion.

B. After completing installation of exposed, factory-finished water-source heat pumps, inspect exposed finishes and repair damaged finishes.

3.8 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain water-source heat pumps. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION 23 81 46

SECTION 26 05 00 – COMMON WORK RESULTS FOR ELECTRICAL

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Electrical equipment coordination and installation.
2. Common electrical installation requirements specified under Division 26.

1.2 QUALITY ASSURANCE

A. Regulations: Work, materials and equipment shall comply with the latest rules and regulations specified in National Fire Protection Association (NFPA).

B. Discrepancies: The Drawings and Specifications are intended to comply with listed codes, ordinances, regulations and standards. Where discrepancies occur, immediately notify the Owner's Representative in writing and ask for an interpretation. Should installed materials or workmanship fail to comply, the Contractor is responsible for correcting the improper installation at no additional cost to the Owner. Additionally, where sizes, capacities, or other such features are required in excess of minimum code or standards requirements, provide those specified or shown.

C. Warrant electrical work against faulty material or Workmanship in accordance with Division 01. If the project is occupied or systems are placed in operation in phases at the request of the Owner's Representative, then the warranty of each system or piece of equipment, shall begin on the date each system or component was placed in operation as designed and accepted as such, in writing, by the Owner's Representative. The use of equipment for temporary service and testing does not constitute the beginning of the warranty.

D. Equipment and materials provided and installed under this Division shall periodically be inspected and serviced by competent mechanics or technicians. This function becomes the responsibility of the Owner's Representative when the system is accepted, in writing, by the Owner's Representative. The material and Workmanship warranty is not intended to supplant normal inspection or service and shall not be construed to mean the Contractor shall provide free service for normal maintenance items such as periodic lubrication and adjustment due to normal use, nor to correct, without charge, breakage, maladjustment, and other trouble caused by improper maintenance.

E. Upon completion of contract and progressively as work proceeds, clean up dirt, debris and scrap materials. Maintain premises neat and clean throughout. Protect and preserve access to energized equipment at all times. Clean items with factory finishes. Touch up minor damage to surfaces; refinish entire piece of equipment in the event of major damage as determined by Owner's Representative. Use only factory supplied paints of matching color and formula. Schedule an off-hour shutdown of all electrical equipment during the 2-week period preceding substantial completion. During this shutdown, clean all busses and insulators inside switchgear, transformers and panel boards located inside or adjacent to the project limits.

1.3 STANDARDS

A. Perform all work specified in Division 26 in strict accordance with the following codes and standards, latest edition, adopted by the authority having jurisdiction (AHJ). Where these specifications are more stringent than the AHJ, these specifications shall take precedence.

1. National Electric Code NFPA 70 (NEC).
2. ASHRAE 90.1 energy standard for building except low rise residential buildings - 2016 edition
3. Life Safety Code NFPA 101.
4. International Building Code (IBC).
5. National Electric Safety Code (NESC).
6. Association of Edison Illuminating Companies (AEIC).
7. American National Standards Institute (ANSI).
8. American Society for Testing Materials (ASTM).
9. Certified Ballast Manufacturers (CBM).
10. Electrical Testing Laboratories (ETL).
11. Insulated Cable Engineers Association (ICEA).
12. Institute of Electrical and Electronic Engineers (IEEE).
13. National Electrical Contractors Association (NECA)
14. National Electrical Manufacturer's Association (NEMA)
15. Underwriters Laboratories, Inc. (UL)
16. All applicable OSHA Publications.

1.4 SUBMITTALS

A. Comply with provisions in accordance with Division 01.

B. Submit data specified in Division 26 Sections.

C. Product Data: Submit the following in addition to, and in accordance with, the requirements of Uniform General Conditions and Division 01, Submittals.

1. Provide the following with each submittal:
2. Catalog cutsheets with manufacturer’s name clearly indicated. Applicable portions shall be clearly indicated and non-applicable portions shall be clearly crossed out. Submittals without clear markings of applicable portions will be returned Rejected – Resubmit.
3. Schematic, connection and/or interconnection diagrams: Manufacturer’s standardized schematic diagrams and catalog cutsheets shall not be acceptable unless applicable portions are clearly indicated and non-applicable portions clearly deleted or crossed out.
4. Inspection and permit certificates and certificates of final inspection and acceptance from the AHJ.

D. Installation: Where product data or shop drawings are required, do not install equipment or materials until submittals are accepted by the Architect/Engineer and by Owner’s Representative. Use only equipment and materials accepted by the Architect/Engineer and by Owner’s Representative. Equipment and materials installed prior to acceptance by the Architect/Engineer and Owner’s Representative shall be removed at no additional cost to Owner and replaced at the Contractor’s expense.

E. Startup and Test Procedures:

1. Assemble documentation from equipment manufacturer for the startup and field testing procedures for equipment installed as a part of this project.

2. Startup and testing procedures shall include prerequisite conditions, system or equipment alignments and lineups, sequential steps for execution of the test, shutdown procedures, and criteria for satisfactory test completion and test failure.
3. Startup and testing procedures shall address and demonstrate all modes of system or equipment operation, including startup, manual, unattended/automatic, and shutdown procedures, as well as procedures for testing and demonstration of abnormal or emergency operating conditions.
4. Include forms and logs to be used during field testing. Forms and logs shall include the range of permissible values for monitored parameters, as applicable.

1.5 OPERATION AND MAINTENANCE MANUALS

A. Comply with provisions of Division 01.

B. In addition to required submittals, manuals shall include copies of all test reports specified in Division 26.

C. Provide completed warranty certificates for systems and equipment.

1.6 RECORD DRAWINGS

A. Comply with provisions of Division 01.

PART 2 - PRODUCTS

2.1 PRODUCT REQUIREMENTS

A. Condition: Provide new products of manufacturers regularly engaged in production of such equipment. Provide the manufacturer's latest standard design for the type of product specified.

B. Manufacturer:

1. Where two or more units of the same class of material are required, provide products of a single manufacturer. Component parts of materials or equipment need not be products of the same manufacturer, except as specifically noted in individual Sections of the specifications.
2. Other manufacturers: As listed in the individual specification Sections. Manufacturers listed on Drawings are generally indicative of the features, ratings and quality of construction for equipment and devices to accomplish the intended function, and do not infer or imply a sole-source of supplier, except where “no substitution” is specifically indicated.

C. NEC and UL: Products must conform to requirements of the National Electrical Code. Where Underwriters' Laboratories have set standards, listed products and issued labels, products used must be listed and labeled by UL.

D. Space Limitations: Equipment selected must conform to the building features and must be coordinated with them. Electrical installation shall comply with the requirements of Article 110.26 and Article 110.34 of the National Electrical Code (NEC) for working space, access, and dedicated equipment space. Do not provide equipment that will not suit arrangement and

space limitations. Prepare scaled coordination drawings, (1/4" = 1'-0") of electrical and telecommunication rooms for coordination with structure and with adjacent trades prior to installing equipment and systems.

E. Physical Size of Equipment: Equipment of larger sizes than shown, even though of specified manufacturer, will not be acceptable unless the Contractor demonstrates by product data, shop drawings, and coordination drawings that ample space exists for proper installation, operation, and maintenance.

F. Enclosure: Provide NEMA 1 enclosure for indoor installation, NEMA 3R for outdoor enclosure, and NEMA 4X for corrosive environments unless noted or specified otherwise. The enclosure shall be suitable for the environment per NEC, NEMA and ANSI standards.

G. Factory Finish: Equipment shall be delivered with a hard surface, factory-applied finish so that no additional field painting is needed except for touch-up as required.

H. Device Terminations.

1. Terminals shall be marked and suitable for termination of conductors using 75°C insulation system. Terminals marked as suitable for termination of 60°/75°C conductors shall also be acceptable.
2. Terminals marked as suitable for termination of conductors using 60°C insulation system are not acceptable.

PART 3 - EXECUTION

3.1 COMMON REQUIREMENTS FOR ELECTRICAL INSTALLATION

A. Comply with NECA 1.

B. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items.

C. Headroom Maintenance: Where mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.

D. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both electrical equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.

E. Right of Way: Give to piping systems installed at a required slope.

F. Drawings are diagrammatic by their nature and are not intended to show every connection in detail or every pipe or conduit in its exact location. Carefully investigate structural and finish conditions and coordinate the separate trades in order to avoid interference between the various phases of Work. Organize and lay out Work 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. Install all Work parallel or perpendicular to building lines unless otherwise noted.

G. The intent of the Drawings is to establish the types of systems and functions; not to set forth each item essential to the functioning of the system. Install the Work complete, including minor details

necessary to perform the function indicated. Review pertinent Drawings and adjust the Work to conditions shown. Where discrepancies occur between Drawings, Specifications, and actual field conditions, immediately notify the Owner's Representative for Owner's interpretations.

H. All dimensional information related to new structures shall be taken from the appropriate Drawings.

I. Existing Structures: The building floor slabs, structure, and outer walls are generally existing to remain. The only existing penetrations are openings where indicated on the Drawings. This Contract requires the Contractor to core drill all other floor or wall penetrations as required. All floor penetrations shall include a sleeve that extends 2-inches above the floor. Bus duct penetrations shall have a minimum 4-inch high curb as per NEC requirement or per drawing, whichever is higher.

3.2 COORDINATION

A. Coordinate arrangement, mounting, and support of electrical equipment:

1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
2. To provide for ease of disconnecting the equipment with minimum interference to other installations.
3. To allow right of way for piping and conduit installed at required slope.
4. So connecting raceways, cables, wireways, cable trays, and busways will be clear of obstructions and of the working and access space of other equipment.

B. Coordinate the actual locations of electrical outlets and equipment with building features and equipment as indicated on architectural, structural, mechanical, and plumbing drawings. Review any proposed changes in electrical wiring devices or equipment location with the Owner and Architect/Engineer. Owner's Representative or Architect/Engineer may direct relocation of wiring devices (outlets, data drops, switches, etc…) before installation, up to 5-feet from the position indicated, without additional cost. Remove and relocate outlets placed in an unsuitable location when requested by the Owner's Representative, at no additional cost to the Owner.

C. Coordinate all items which will affect the installation of the work of this Division. This coordination shall include, but not be limited to, voltage, ampacity, capacity, connections, space requirements, sequence of construction, building requirements and special conditions.

D. Examine specifications and drawings for all equipment and systems that require electrical connections and coordination.

E. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.

F. Coordinate location of access panels and doors for electrical items that are behind finished surfaces or otherwise concealed.

G. Coordinate sleeve selection and application with selection and application of firestopping requirements.

H. Electrical drawings are diagrammatic only and shall not be scaled for exact sizes.

I. Coordinate all work with other trades prior to beginning work.

J. By submitting shop drawings on the project, it is to be understood that the contractor is indicating that all necessary coordination has been completed and that the systems, products and equipment submitted can be installed and will operate as specified and intended, in full coordination with all other trades.

3.3 PROTECTION OF EQUIPMENT

A. General:

1. The Contractor shall follow the manufacturer's directions completely in the delivery, storage and handling of equipment and materials.
2. Equipment and materials shall be tightly covered and protected against dirt, water, chemical, physical or weather damage and theft. At the completion of the work, fixtures, equipment and materials shall be cleaned and polished thoroughly and shall be returned to "as new" condition.
3. Electrical cable, wire, and conductors shall be stored to prevent moisture and mechanical damage.

B. Moisture: During construction, protect switchgear, panelboards, transformers and other items from insulation moisture absorption and metallic component corrosion by appropriate use of covers, strip heaters, lamps or other suitable means. Apply protection immediately upon receiving the products and maintain continually.

C. Clean: Keep products clean by elevating above ground or floor and by using suitable coverings.

D. Damage: Take such precautions as are necessary to protect apparatus and materials from damage. Failure to protect materials is sufficient cause for rejection of the apparatus or material in question.

E. Finish: Protect factory finish from damage during construction operations and until Owner’s Representative acceptance of the project. Satisfactorily restore finishes that become stained or damaged.

F. Weather: Protect equipment and materials from weather and sunlight by use of suitable coverings and storage indoors or in suitable weather-protected containers. Materials and equipment marked by the manufacturer as suitable for storage outdoors may be stored according to manufacturer’s markings. Maintain factory-installed coverings and wrappings until material is to be installed.

3.4 INSTALLATION

A. Cooperation with Other Trades: Cooperation with trades of adjacent, related or affected materials or operations, and of trades performing continuations of this work under subsequent contracts, is considered a part of this work in order to effect timely and accurate placing of work and to bring together, in proper and correct sequence, the work of such trades. Provide other trades, as required, templates, patterns, setting plans and shop details for the proper installation of the work and for the purpose of coordinating adjacent work. Electrical power connections for mechanical and plumbing equipment are in this Division unless noted otherwise. Verify electrical characteristics of equipment with other Divisions before roughing in the electrical connections. Improperly coordinated and installed electrical work shall be removed and re-installed at no additional cost to Owner.

B. Workmanship: Work shall be performed by workmen skilled in their trade. The installation shall be complete and installed in a neat and workmanlike manner in accordance with NEC 110.12 and FPN accompanying, and as described in ANSI/NECA 1-2010 “Standard Practice for Good Workmanship in Electrical Construction,” and other ANSI approved installation standards.

C. Concrete Equipment Pads:

1. Where not otherwise indicated, install 4-inch thick concrete foundation pads for indoor floor-mounted equipment, except where direct floor mounting is required. For equipment mounted outdoors, provide concrete foundation pads a minimum of 4-inches above grade. Provide reinforcing steel as recommended by the structural engineer and as detailed on the Drawings. Pour pads on roughened floor slabs, sized so that outer edges extend a minimum of 3-inches beyond equipment. Trowel pads smooth and chamfer edges to a 1-inch bevel. Secure equipment to pads as recommended by the manufacturer.
2. Anchor Bolts. Furnish and install galvanized anchor bolts for equipment placed on concrete equipment pads or on concrete slabs. Bolts shall be of the size and number recommended by the manufacturer of the equipment and shall be located by means of suitable templates. When equipment is placed on vibration isolators, the equipment shall be secured to the isolator and the isolator secured to the floor, pad, or support as recommended by the vibration isolation manufacturer.

D. Setting of Equipment: Provide permanent and temporary shoring, anchoring, and bracing required to make parts stable and rigid; even when such shoring, anchoring, and bracing are not explicitly called for.

1. Equipment must be leveled and set plumb.
2. Sheet metal enclosures mounted against a wall shall be separated from the wall not less than 1/4-inch by means of corrosion-resistant spacers or by 3-inches of air for freestanding units. Use corrosion-resistant bolts, nuts and washers to anchor equipment.
3. In sufficient time to be coordinated with work under other Divisions, provide coordination drawings, shop drawings, and layout work showing exact size and location of sleeves, openings or inserts for electrical equipment in slabs, walls, partitions and chases.
4. Provide adequate support for freestanding panels, switchboards, enclosures, and other equipment. This shall include bolting to the floor, concrete equipment pad, or solid structural steel to prevent tipping. Install free-standing electrical equipment on concrete equipment pads in accordance with paragraph 3.4C, this Section, except where equipment is noted and designed for mounting directly on the concrete floor slab. Under no condition shall equipment be fastened to non-rigid building steel (i.e., removable platform steel gratings, handrails, etc.).
5. Provide racks and supports, independently mounted at structure, to support electrical equipment and systems supplied and installed under this contract. Do not mount or suspend equipment from supports provided for equipment and systems by other Divisions, except where specifically noted or indicated on Drawings.
6. Refer to Section 26 05 29 “Hangers and Supports for Electrical Systems”, for additional requirements.

E. Sealing of Equipment: Seal openings into equipment to prevent entrance of animals, birds and insects, as well as to prevent ingress of moisture, dust, dirt, and similar contaminants.

F. Miscellaneous Control Power:

1. Electrical work includes the connection of control wiring (120V and above) to equipment, except for wiring provided as part of the equipment.
2. Equipment shall include, but not be limited to, the following:

a. Fire dampers.
b. Combination fire/smoke dampers.
c. Motorized dampers.
d. Dampers with actuators.
e. Building management system (BMS) control panels.

3. Control wiring (120V and above) specifically scheduled and specified under the scope of other Divisions shall be provided under the scope of Division 26, with no additional costs to the Owner. Examine mechanical, plumbing and fire alarm drawings and equipment schedules for control wiring requirements and coordinate installation of control wiring with other Divisions.

G. Concealed Work: Conceal electrical work in walls, floors, chases, under floors, underground and above ceilings except:

1. Where shown or specified to be exposed. Exposed is understood to mean open to view.
2. Where exposure is necessary to the proper function.
3. Where size of materials and equipment preclude concealment. Obtain the written consent of the Owner's Representative and the Architect/Engineer to leave materials exposed in finished spaces of the building.

H. Application: Unless otherwise indicated, power will be utilized as follows:

1. 120, 277 volts, single phase: LED lighting.
2. 120 volts, single phase: motors smaller than 3/4 horsepower.
3. 208 volts, three phase: motors 3/4 horsepower and larger.
4. 480 volts, three phase: motors 1 horsepower and larger.
5. 120 volts, single phase: fan-powered boxes.
6. 120 volts, single phase: fan-powered boxes with electric heat up to 2000 watts.
7. 277 volts, single phase: fan-powered boxes with electric heat up to 5000 watts.
8. 208 volts, three phase: fan-powered boxes with electric heat exceeding 2000 watts.
9. 480 volts, three phase: fan-powered boxes with electric heat exceeding 5000 watts.
10. 120 volts, single phase: convenience outlets, dedicated equipment, lab-track terminal boxes without fans.
11. 208 volts, single and three phase: specialty outlets.
12. 480 volts, three phase: special power and equipment; verify for each unit of equipment.

I. Transformers: Use transformers to change the service to the required utilization voltages. In general, use energy-efficient dry-type transformers to transform the electrical service from 480 volts to 208Y/120 volts, 3-phase, 4-wire, Wye, per Section 26 22 00 "Low Voltage Transformers", and as per the Drawings.

J. Connections to Equipment - Other than Division 26: For equipment furnished under other Divisions and for equipment furnished by the Owner, provide final electrical connections to such items of equipment. Obtain detailed shop drawings of equipment from the applicable Division or supplier indicating the exact number and location of rough-in points. Such final shop drawings may indicate adjustments in total number and exact location of rough-in points, and in equipment dimensions. Making adjustments to field conditions is considered a part of the work required.

1. Roughing-in: When roughing-in, provide electrical branch circuits to various items of equipment. Terminate at proper points as indicated on detailed equipment shop drawings or as directed. Use Drawings accompanying these specifications only for general routing of circuiting. Do not use Drawings accompanying these specifications for rough-in locations.
2. Final Connections: Millwork, casework, and similar equipment will include service fittings such as switches, duplex receptacles, data/communications outlets, and luminaires, on

the casework or equipment. Provide branch circuit connection to match electrical connection requirements of service fittings.

K. Accessories: Offsets, fittings, expansion joints, anchors and accessories that are required for a complete system shall be provided even if not specifically indicated on the Drawings or mentioned in the specifications. Offsets, transitions and changes in direction of conduit, cable trays, raceways and busways shall be made to maintain proper headroom. Provide pullboxes, fittings, etc., required as a result of these transitions and changes in direction.

L. Observation prior to cover-up or seal-in of walls and ceilings. Perform the following in accordance with the applicable requirements of Division 01 and the General Conditions:

1. Prior to the installation of ceiling material, gypsum, plaster, or acoustical board, the Contractor shall notify the Owner's Representative so that arrangement can be made for observation or inspection of the above-ceiling area about to be "sealed" off. The Contractor shall provide advance notice in accordance with the applicable requirements of Division 01 and the General Conditions. Where not specified, required, or directed elsewhere provide not less than 10-working days advance notice.
2. Above-ceiling areas will be subject to a formal inspection before ceiling panels are installed, or installation is otherwise concealed from view. Electrical work at and above the ceiling, including items supported by the ceiling grid, shall be complete and installed in accordance with contract requirements, including power to luminaires, fans, and other powered items. The purpose of this inspection is to verify the completeness and quality of the installation of the electrical systems and other special above ceiling systems such as cable tray systems. The ceiling supports shall be in place so that access panel and luminaire locations are identifiable and so that clearances and access provisions may be evaluated.
3. No ceiling materials may be installed until the resulting deficiency list from this inspection is completed and approved by the Owner's Representative.

M. Finish. Coordinate with Division 09 to paint exposed conduit to match adjacent walls, unless otherwise directed.

3.5 CLEANING, ADJUSTING, AND START-UP

A. Cleaning: Clean electrical equipment, components, and devices prior to installation of final finish or covers, prior to startup and testing, prior to final observation by Architect/Engineer and Owner's Representative, and as required under individual Sections of the Division 26 specifications.

B. Adjusting: Adjust equipment, devices, and systems as specified under individual Sections of these specifications and in accordance with manufacturer’s instructions for proper functioning during all modes of operation, including emergency and shutdown conditions.

C. Factory Authorized Representative: Where specified for an individual item of electrical equipment, provide a factory authorized representative for adjustment, start-up, and testing of equipment, and instruction of Owner's operating personnel. Certify that these services have been performed by including a properly executed invoice for these services or a letter from the manufacturer.

3.6 TESTING

A. Test Conditions: Using field startup and testing procedures submitted in accordance with Part 1 of this Section and accepted by the Owner’s Representative and the Architect/Engineer, place circuits and equipment into service under normal conditions, collectively and separately, as may be required to demonstrate satisfactory operation. Perform specified tests in the presence of the Owner's Representative. Furnish instruments, wiring, equipment, and personnel required for conducting tests. Demonstrate that the equipment operates in accordance with requirements of the Drawings and specifications. Special tests on certain items, when required, are specified in the individual specification Sections. Where testing is specified or otherwise required to be performed by an independent testing company, use an Owner-approved NETA-certified testing company.

B. Test Dates: Schedule final acceptance tests sufficiently in advance of the contract completion date to permit adjustment or alterations within the number of days allotted for completion of the contract. Inform the Owner's Representative in advance of test dates in accordance with the applicable requirements of Division 01 and the General Conditions. Where not specified, required, or directed otherwise, allow a minimum of at least 10-working days advance notice.

C. Retests: Conduct retests as directed by the Owner's Representative of such time duration as may be necessary to assure proper functioning of adjusted or altered parts or items of equipment. Delays due as a result of necessary retests do not relieve the Contractor of his responsibility under this contract.

D. Commissioning: Coordinate with commissioning agent, as applicable, for field testing and commissioning of electrical components and systems.

E. Test Reports: Submit copies of test reports to the Architect/Engineer in accordance with Division 01 requirements.

3.7 INSPECTION FEES AND PERMITS

A. Contractor shall obtain and pay for all necessary permits and inspection fees for all systems covered under Division 26.

END OF SECTION 26 05 00

SECTION 26 05 19 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Copper building wire rated 600V or less.
2. Aluminum building wire rated 600V or less.
3. Metal-clad cable, Type MC, rated 600V or less.
4. Listed 2-hour fire rated systems, rated 600V or less.
5. Connectors, splices, and terminations rated 600V and less.

B. Related Requirements:

1. Section 26 05 23 "Control-Voltage Electrical Power Cables" for control systems communication cables and Classes 1, 2, and 3 control cables.

1.3 DEFINITIONS

A. RoHS: Restriction of Hazardous Substances.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.5 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Provide factory-wrapped water-proof flexible barrier material for covering wire and cable wood reels, where applicable; and weather resistant fiberboard containers for factory-packaging of cable, wire and connectors, to protect against physical damage in transit. Damaged cable, wire or connectors shall not be used and shall be removed from project site.

B. Store cable, wire and connectors in their factory-furnished coverings in a clean, dry indoor space elevated above grade, which provides protection against the weather and sunlight.

C. Protect the exposed cable ends with shrinkable, molded polyolefin end caps or other suitable means such as standard conduit sealing compound and PVC tape.

D. Products, packages, and reels shall not be used as work tables, scaffolds, or ladders.

E. Handle products carefully to avoid damage to material components, and to avoid abrasions to the outer jacket. Use only lifting means and brackets provided for that purpose. Damaged products shall be rejected and not be installed on project.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

A. Wire, cable, and connectors shall be listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use. Provide wire, cable, and connectors of design and construction as required for the installation.

B. Insulated wire and cable shall conform to the minimum requirements of ICEA Standards for Cable Installed in Wet Locations, with the cable subjected to damp and wet moisture conditions. Wire and cable shall comply with the applicable requirements of the NEC, latest edition, in regards to cable construction and usage. Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."

C. The conductors of wires and cables shall have conductivity in accordance with the standardization rules of the IEEE. The conductor and each strand shall be round and free of kinks and defects.

D. Grounding conductors, where insulated, shall be colored solid green or identified with green color as required by the NEC and Section 26 05 26 “Grounding and Bonding” and Section 26 05 53 “Identification for Electrical Systems”.

E. Conductors intended as a neutral (i.e., grounded conductor) shall be colored solid white, or identified as required by the NEC and Section 26 05 53 “Identification for Electrical Systems”.

F. Use compression lugs for termination of stranded conductors, except on circuit breakers or terminal strips in panel boards. Do not use compression lugs on solid wire.

2.2 CONDUCTORS AND CABLES

A. Manufacturers: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

1. Aetna Insulated Wire.
2. Belden Inc.
3. General Cable Corporation.
4. Houston Wire and Cable Company.
5. Prysmian Group.
6. Senator Wire & Cable Company.
7. Southwire Company.

B. Conductors: [Copper] [Aluminum] [Aluminum and copper], complying with NEMA WC 70/ICEA S-95-658.

1. Conductor Insulation: Comply with NEMA WC 70/ICEA S-95-658 for Type THHN/THWN, Type XHHW, Type THHN/THWN-2, Type XHHW-2 and Type SO.

C. Cable: Comply with NEMA WC 70/ICEA S-95-658 for metal-clad cable, Type MC and Type SO with ground wire.

2.3 METAL-CLAD CABLE – TYPE MC

A. Size. No. 12 AWG minimum.

B. Construction:

1. Conductor: Soft-drawn, annealed copper. Solid for No. 12 and No. 10 AWG. Stranded for No. 8 AWG and larger.
2. Insulation: THHN/THWN.
3. Armor: Flexible, spiral-wound, square-locked, hot-dipped galvanized steel strip or aluminum strip. The metallic cable armor shall qualify as an equipment grounding conductor per NEC-517.13(A) and NEC-250.118.(10), and shall be UL-listed as an equipment grounding conductor. The metallic cable armor ground path performance shall be equivalent in performance to an equipment grounding conductor sized per NEC Table 250.122.
4. Sheath: Nylon or plastic outer sheath between insulated conductors and armor.
5. Grounding conductor.

a. Provide a separate, green-insulated grounding conductor as an integral part of the metal-clad multi-conductor cable assembly.
b. Conductor material and insulation shall match phase and neutral conductors in the cable assembly.
c. Size grounding conductor per NEC-250.122, unless shown larger on Drawings.

C. Listing: UL 1569, type MC.

2.4 WIRING CONNECTORS, TERMINATIONS, AND SPLICES

A. Manufacturers: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

1. AFC Cable Systems, Inc.
2. Hubbell Power Systems, Inc.
3. O-Z/Gedney; EGS Electrical Group LLC.
4. 3M; Electrical Products Division.
5. Tyco Electronics Corp.

B. Description: Factory-fabricated metal connectors and splices of size, ampacity rating, material, type, and class for application and service indicated. Where not indicated, provide proper selection as required to comply with installation requirements and with NEC standards. Select from only following classes, kinds and styles:

1. Class: Insulated.

2. Material: Copper (for CU to CU connection). Where terminating conductors at busses, lugs, or terminal strips of dissimilar metals, provide terminator of material suitable for connection of dissimilar metals without corrosion, and without loosening by cyclic thermal expansion and contraction of conductors or terminator materials.
3. Style:

    a. Insulated terminals. Use ring-terminal for control wiring. Use flange (fork) spade compression terminal for termination of stranded conductors at wiring devices, including ground connection.
    b. Split bolt-parallel connector.
    c. Pigtail connector.
    d. Pre-insulated multi-tap connector: NSI Industries “Polaris” series, Ilsco Corp. “Clear Tap” type PST, Burndy/FCI “Unitap”, or accepted substitution.

2.5 PULLING COMPOUND

A. Provide cable pulling lubricant compatible with conductor insulation system and jacket. Pulling compound shall not deteriorate conductor and insulation.

1. Lubricity: PVC or LDPE jacketed cable on PVC conduit at 200 lbs/ft normal pressure; coefficient of dynamic friction <0.15. PVC or LDPE jacketed cable on HDPE inner duct at 200 lbs/ft normal pressure; coefficient of dynamic friction <0.15.
2. Percent non-volatile solids: 3.5 – 5.5%
3. Consistency: Thick gel material.
4. Wax, grease, and silicone content: none.
5. Temperature use range: 20°F to 120°F for standard lubricant, -20°F to 120°F for winter grade.
6. pH: 7.5 – 9.0
7. Cable compatibility: Passes IEEE 1210 physical and electrical.
8. Polyethylene stress cracking: No stress cracking on LDPE cable jacket when tested by ASTM D1693.
9. Cling factor: Twelve inches of a 1-inch diameter cable will hold at least 75 grams of lubricant for one minute when held vertically at 70°F.
10. Temperature stability: No phase-out after five freeze/thaw cycles or 24-hour exposure at 120°F.
11. Toxicity: Non-toxic and non-sensitizing. Industrial use only.
12. Clean-up: Complete clean-up possible with water.
13. Flammability: Lubricant has no flash point, and dried residue will not support or spread flame.

B. Manufacturer: American Polywater Corporation:

1. Standard cable lubricant, temperature use range 20°F to 120°F: Polywater Lubricant J.
2. Winter grade lubricant, temperature use range -20°F to 120°F: Polywater Lubricant WJ.
3. Wax-based compounds are not acceptable.

PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

A. Feeders: Copper; solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger. Aluminum; stranded for No. 4/0 circuits and larger; smaller sizes are not allowed.

B. Branch Circuits: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

3.2 CONDUCTOR INSULATION AND WIRING METHODS

A. Service Entrance: Type THHN/THWN-2, single conductors in raceway or Type XHHW-2, single conductors in raceway.

B. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspaces: Type THHN/THWN, single conductors in raceway.

C. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN/THWN-2, single conductors in raceway or Type XHHW-2, single conductors in raceway.

D. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN/THWN, single conductors in raceway.

E. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN/THWN-2, single conductors in raceway or Type XHHW-2, single conductors in raceway.

F. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with wire mesh, stainless-steel strain relief device at terminations to suit application.

3.3 INSTALLATION OF CONDUCTORS AND CABLES

A. Conceal cables in finished walls, ceilings, and floors unless otherwise indicated.

B. Complete raceway installation between conductor and cable termination points according to Section 26 05 33 "Raceways and Boxes for Electrical Systems" prior to pulling conductors and cables.

C. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.

D. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips which will not damage cables or raceway.

E. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.

F. Horizontal cable runs within walls are not acceptable. Cable runs shall not extend horizontally within walls further than the adjacent gap between framing studs. Any installation of horizontal

cable runs within walls beyond the next adjacent framing stud shall be completely removed and replaced at Contractor's expense.

1. Exception: Receptacles, devices, outlets, and similar devices located in partial-height wall, below windows and similar openings, clerestory panel walls, and where structural conditions do not allow vertical access to tops of walls.

G. Support cables according to Section 26 05 29 "Hangers and Supports for Electrical Systems."

3.4 METAL-CLAD CABLE, TYPE MC

A. Install Type MC cable in accordance with NEC Article 330. Do not install Type MC cable in thermal insulation. Use fittings specifically designed for Type MC cable.

B. Uses:

1. Use of Type MC cable is limited to 72-inches in length and shall be run concealed in walls and above suspended ceiling systems for branch circuit final vertical connection (i.e. "whip" or "drop") to luminaires from an associated junction box in the ceiling plenum. Stringing ("daisy chaining") Type MC cable from luminaire to luminaire is not acceptable.
2. Prior to using or installing Type MC cable in other locations, obtain permission in writing from the Owner for each specific location and application proposed for installation by the Contractor. Any use of Type MC cable other than that listed here will be removed and corrected at Contractor's expense.

C. Conceal cable inside walls. Do not install Type MC cable exposed below the ceiling without specific written permission from the Owner and the Architect/Engineer for each location and application proposed for installation exposed.

3.5 CONNECTIONS

A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.

B. Make splices, terminations, and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than un-spliced conductors.

C. Wiring at Outlets: Install conductor at each outlet, with at least 6-inches of slack.

3.6 IDENTIFICATION

A. Identify and color-code conductors and cables according to Section 26 05 53 "Identification for Electrical Systems."

B. Identify each spare conductor at each end with identity number and location of other end of conductor, and identify as spare conductor.

3.7 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 26 05 44 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

3.8 FIRESTOPPING

A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly

3.9 FIELD QUALITY CONTROL

A. Tests and Inspections

1. Perform each of the following visual and electrical tests:

a. Inspect exposed sections of conductor and cable for physical damage and correct connection according to the single-line diagram.
b. Test bolted connections for high resistance using one of the following:

1) A low-resistance ohmmeter.
2) Calibrated torque wrench.
3) Thermographic survey.

c. Inspect compression applied connectors for correct cable match and indentation.
d. Inspect for correct identification.
e. Inspect cable jacket and condition.
f. Insulation-resistance test on each conductor with respect to ground and adjacent conductors. Apply a potential of 500V dc for 300V rated cable and 1000V dc for 600V rated cable for a one-minute duration.
g. Continuity test on each conductor and cable.
h. Uniform resistance of parallel conductors.

B. Cables will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports to record the following:

1. Procedures used.
2. Results that comply with requirements.
3. Results that do not comply with requirements and corrective action taken to achieve compliance with requirements.

END OF SECTION 26 05 19

SECTION 26 05 26 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes:

1. Grounding and bonding systems and equipment
2. Underground distribution grounding.
3. Ground bonding common with lightning protection system.
4. Foundation steel electrodes.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

1.4 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For grounding to include in emergency, operation, and maintenance manuals.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Comply with UL 467 for grounding and bonding materials and equipment.

2.2 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, [products that may be incorporated into the Work include, but are not limited to, the following:] [provide products by one of the following:]

1. ABB Group; Thomas & Betts Products.
2. Pentair PLC; ERICO Products.

2.3 CONDUCTORS

A. Insulated Conductors: Copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.

B. Bare Copper Conductors:

1. Solid Conductors: ASTM B 3.
2. Stranded Conductors: ASTM B 8.
3. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, 1/4-inch in diameter.
4. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
5. Bonding Jumper: Copper tape, braided conductors terminated with copper ferrules; 1-5/8-inches wide and 1/16-inch thick.

C. Grounding Bus: Predrilled rectangular bars of annealed copper, 1/4-by-4-inches in cross section, with two rows of 7/16-inch holes spaced 2-inches apart. Insulators shall mount on type 304 stainless steel stand-off brackets, and shall comply with UL 891 for use in switchboards, 600 V and shall be Lexan or PVC, impulse tested at 5000 V.

2.4 CONNECTORS

A. Listed and labeled by an NRTL acceptable to authorities having jurisdiction for applications in which used and for specific types, sizes, and combinations of conductors and other items connected.

B. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

C. Bus-Bar Connectors: Mechanical type, cast silicon bronze, solderless compression-type wire terminals, and long-barrel, two-bolt connection to ground bus bar.

D. Beam Clamps: Mechanical type, terminal, ground wire access from four directions, with dual, tin-plated or silicon bronze bolts.

E. Cable-to-Cable Connectors: Compression type, copper or copper alloy.

F. Cable Tray Ground Clamp: Mechanical type, zinc-plated malleable iron.

G. Conduit Hubs: Mechanical type, terminal with threaded hub.

H. Ground Rod Clamps: Mechanical type, copper or copper alloy, terminal with hex head bolt.

I. Lay-in Lug Connector: Mechanical type, copper rated for direct burial terminal with set screw.

J. Service Post Connectors: Mechanical type, bronze alloy terminal, in short- and long-stud lengths, capable of single and double conductor connections.

K. Straps: Solid copper, copper lugs. Rated for 600 A.

L. U-Bolt Clamps: Mechanical type, copper or copper alloy, terminal listed for direct burial.

M. Water Pipe Clamps:

1. Mechanical type, two pieces with stainless-steel bolts.

   a. Material: Tin-plated aluminum.
   b. Listed for direct burial.

2. U-bolt type with malleable-iron clamp and copper ground connector rated for direct burial.

2.5 GROUNDING ELECTRODES

A. Ground Rods: Copper-clad steel; 3/8-inch by 96-inches.

PART 3 - EXECUTION

3.1 APPLICATIONS

A. Conductors: Install solid conductor for No. 8 AWG and smaller, and stranded conductors for No. 6 AWG and larger unless otherwise indicated.

B. Underground Grounding Conductors: Install bare copper conductor, No. 2/0 AWG minimum.

C. Grounding Bus: Install in electrical equipment rooms housing main service equipment, in electrical equipment rooms with low-voltage transformers, and elsewhere as indicated.

1. Install bus horizontally, on insulated brackets 3-inches minimum from wall, and 12-inches minimum above finished floor, or as otherwise indicated.

D. 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 Structural Steel: Welded connectors.
4. Connections to Ground Rods at Test Wells: Bolted connectors.

3.2 EQUIPMENT GROUNDING

A. Install insulated equipment grounding conductors with all feeders and branch circuits.

B. Install insulated equipment grounding conductors with the following items listed below, in addition to those required by NFPA 70:

1. Feeders and branch circuits.
2. Lighting circuits.
3. Receptacle circuits.
4. Single-phase motor and appliance branch circuits.
5. Three-phase motor and appliance branch circuits.
6. Flexible raceway runs.
7. Metal-clad cable runs.

C. Air-Duct Equipment Circuits: Install insulated equipment grounding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners, heaters, dampers, humidifiers, and other duct electrical equipment. Bond conductor to each unit and to air duct and connected metallic piping.

3.3 INSTALLATION

A. Grounding Conductors: Route along shortest and straightest paths possible unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.

B. Ground Bonding Common with Lightning Protection System: Comply with NFPA 780 and UL 96 when interconnecting with lightning protection system. Bond electrical power system ground directly to lightning protection system grounding conductor at closest point to electrical service grounding electrode. Use bonding conductor sized same as system grounding electrode conductor, and install in conduit.

C. Ground Rods: Drive rods until tops are 2 inches 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.

D. Test Wells: Ground rod driven through drilled hole in bottom of handhole. Handholes are specified in Section 26 05 43 "Underground Ducts and Raceways for Electrical Systems," and shall be at least 12-inches deep, with cover.

1. Install at least one test well for each service unless otherwise indicated. Install at the ground rod electrically closest to service entrance. Set top of test well flush with finished grade or floor.

E. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance except where routed through short lengths of conduit.

1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install bonding so vibration is not transmitted to rigidly mounted equipment.
3. Use exothermic-welded connectors for outdoor locations; if a disconnect-type connection is required, use a bolted clamp.

F. 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; use a bolted clamp connector or bolt a lug-type connector to a pipe flange by 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.

G. Bonding Interior Metal Ducts: Bond metal air ducts to equipment grounding conductors of associated fans, blowers, electric heaters, and air cleaners. Install bonding jumper to bond across flexible duct connections to achieve continuity.

H. Grounding for Steel Building Structure: Install a driven ground rod at base of each corner column and at intermediate exterior columns at distances not more than 60-feet apart.

I. Ground Ring: Install a grounding conductor, electrically connected to each building structure ground rod and to each steel column, extending around the perimeter of building.

1. Install copper conductor not less than No. 2/0 AWG for ground ring and for taps to building steel.
2. Bury ground ring not less than 24-inches from building's foundation.

J. Concrete-Encased Grounding Electrode (Ufer Ground): Fabricate according to NFPA 70; use a minimum of 20-feet of bare copper conductor not smaller than No. 4 AWG.

1. If concrete foundation is less than 20-feet 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's grounding grid or to grounding electrode external to concrete.

3.4 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
2. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.
3. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, at ground test wells. Make tests at ground rods before any conductors are connected.

   a. Measure ground resistance no fewer than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
   b. Perform tests by fall-of-potential method according to IEEE 81.

4. Prepare dimensioned Drawings locating each test well, ground rod and ground-rod assembly, and other grounding electrodes. Identify each by letter in alphabetical order, and key to the record of tests and observations. Include the number of rods driven and their depth at each location, and include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.

B. Grounding system will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

D. Report measured ground resistances that exceed the following values:

1. Power and Lighting Equipment or System with Capacity of 500 kVA and Less: 10 ohms.
2. Power and Lighting Equipment or System with Capacity of 501 to 1000 kVA: 5 ohms.
3. Power and Lighting Equipment or System with Capacity More Than 1000 kVA: 3 ohms.
4. Power Distribution Units or Panelboards Serving Electronic Equipment: 2 ohms.
5. Substations and Pad-Mounted Equipment: 5 ohms.
6. Manhole Grounds: 10 ohms.

E. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.

END OF SECTION 26 05 26

SECTION 26 05 29 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Hangers and supports for electrical equipment and systems.
2. Construction requirements for concrete bases.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for the following:

a. Hangers.
b. Steel slotted support systems.
c. Trapeze hangers.
d. Clamps.
e. Turnbuckles.
f. Sockets.
g. Eye nuts.
h. Saddles.
i. Brackets.

2. Include rated capacities and furnished specialties and accessories.

B. Shop Drawings: Signed and sealed by a qualified professional engineer. For fabrication and installation details for electrical hangers and support systems.

1. Trapeze hangers. Include product data for components.
2. Steel slotted-channel systems.
3. Equipment supports.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plan(s) and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Suspended ceiling components.

2. Structural members to which hangers and supports will be attached.
3. Size and location of initial access modules for acoustical tile.
4. Items penetrating finished ceiling, including the following:

    a. Lighting fixtures.
    b. Air outlets and inlets.
    c. Speakers.
    d. Sprinklers.
    e. Access panels.
    f. Projectors.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame Rating: Class 1.
2. Self-extinguishing according to ASTM D 635.

2.2 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, products that may be incorporated into the Work include, but are not limited to, the following:

    a. Allied Tube & Conduit; a division of Atkore International, Inc.
    b. Cooper B-Line; a division of Cooper Industries.
    c. ERICO; a division of Pentair PLC.
    d. GS Metals Corp.
    e. Thomas & Betts Corporation; a member of the ABB Group.
    f. Unistrut; a division of Atkore International, Inc.

2. Material: Galvanized steel.
3. Channel Width: 1-5/8 inches.
4. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
5. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
6. Channel Dimensions: Selected for applicable load criteria.

B. Aluminum Slotted Support Systems: Comply with MFMA-4 factory-fabricated components for field assembly.

1. Manufacturers: Subject to compliance with requirements, products that may be incorporated in to the Work include, but are not limited to, the following:

    a. Allied Tube & Conduit; a division of Atkore International, Inc.
    b. Cooper B-Line; a division of Cooper industries.
    c. ERICO; a division of Pentair PLC.

d. GS Metals Corp.
e. Thomas & Betts Corporation; a member of the ABB Group.
f. Unistrut; a division of Atkore International, Inc.

2. Channel Width: 1-5/8 inches.
3. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
4. Channel Dimensions: Selected for applicable load criteria.

C. Conduit and Cable Support Devices: Steel 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 made of malleable iron.

E. 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, products that may be incorporated into the Work include, but are not limited to, the following:

1) Hilti Corporation
2) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
3) MKT Fastening, LLC.
4) Simpson Strong-Tie Company, Inc.
5) Masterset Fastening Systems, Inc.

2. Mechanical-Expansion Anchors: Insert-wedge-type, stainless steel, for use in hardened portland cement concrete, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.

a. Manufacturers: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

1) Cooper B-Line; a division of Cooper Industries.
2) Empire Industries, Inc.
3) Hilti Corporation.
4) ITW Fastening; a division of Illinois Tool Works, Inc.
5) MKT Fastening, LLC.

3. Concrete Inserts: Steel or malleable-iron, slotted support system units are similar to MSS Type 18 units and comply with MFMA-4 or MSS SP-58.
4. Clamps for Attachment to Steel Structural Elements: MSS SP-58 units are suitable for attached structural element.
5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
6. Toggle Bolts: Stainless-steel springhead type.
7. Hanger Rods: Threaded steel.

PART 3 - EXECUTION

3.1 APPLICATION

A. Comply with NECA 1 and NECA 101 for application of hangers and supports for electrical equipment and systems unless requirements in this Section are stricter.

B. Comply with requirements for raceways and boxes specified in Section 26 05 33 "Raceways and Boxes for Electrical Systems."

C. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMTs, IMCs, and RMCs as required by NFPA 70. Minimum rod size shall be 1/4-inch in diameter.

D. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted support system, sized so capacity can be increased by at least 25% in future without exceeding specified design load limits.

1. Secure raceways and cables to these supports with two-bolt conduit clamps.

E. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2-inch and smaller raceways serving branch circuits and communication systems above suspended ceilings and for fastening raceways to trapeze supports.

3.2 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, EMTs, IMCs, and RMCs may be supported by openings through structure members, according to 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. Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete 4-inches thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4-inches thick.
6. To Steel: Welded threaded studs complying with AWS D1.1/D1.1M, with lock washers and nuts
7. To Light Steel: Sheet metal screws.

8. 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 the need for reinforcing bars.

3.3 CONCRETE BASES

A. Construct concrete bases of dimensions indicated but not less than 4-inches larger in both directions than supported unit, and so anchors will be a minimum of 10 bolt diameters from edge of the base.

B. Use 3000-psi, 28-day compressive-strength concrete. Concrete materials, reinforcement, and placement requirements are specified in Section 03 30 00 "Cast-in-Place Concrete."

C. Anchor equipment to concrete base as follows:

1. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
2. Install anchor bolts to elevations required for proper attachment to supported equipment.
3. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

3.4 PAINTING

A. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 26 05 29

SECTION 26 05 33 - RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Metal conduits, tubing, and fittings.
2. Nonmetal conduits, tubing, and fittings.
3. Metal wireways and auxiliary gutters.
4. Nonmetal wireways and auxiliary gutters.
5. Surface raceways.
6. Boxes, enclosures, and cabinets.
7. Handholes and boxes for exterior underground cabling.

1.3 DEFINITIONS

A. ARC: Aluminum rigid conduit.

B. EMT: Electrical metallic tubing.

C. ENT: Electrical nonmetallic tubing.

D. FMC: Flexible metal conduit.

E. GRC: Galvanized rigid steel conduit.

F. IMC: Intermediate metal conduit.

G. LFMC: Liquid tight flexible metal conduit.

H. LFNC: Liquid tight flexible nonmetallic conduit.

I. RNC: Rigid nonmetallic conduit.

1.4 ACTION SUBMITTALS

A. Product Data: For raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.

B. Shop Drawings: For the following raceway components, include plans, elevations, sections, and attachment details.

1. Custom enclosures and cabinets.
2. For handholes and boxes for underground wiring, including the following:
   a. Duct entry provisions, including locations and duct sizes.
   b. Frame and cover design.
   c. Grounding details.
   d. Joint details.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Conduit routing plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of items involved:

1. Structural members in paths of conduit groups with common supports.
2. HVAC and plumbing items and architectural features in paths of conduit groups with common supports.

B. Source quality-control reports.

PART 2 - PRODUCTS

2.1 METAL CONDUITS, TUBING, AND FITTINGS

A. Manufacturers: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

1. AFC Cable Systems; a division of Atkore International, Inc.
2. Allied Tube & Conduit; a division of Atkore International, Inc.
3. Anamet Electrical, Inc.; Anaconda Metal Hose.
4. Electri-Flex Company.
5. Maverick Tube Corporation; a division of Tenaris S.A.
6. O-Z Gedney; a unit of Emerson Electric Company.
7. Wheatland Tube; a division of Zekelman Industries.
8. Rob Roy Plastibond (for PVC-RGS); no substitutions.

B. Listing and Labeling: Metal conduits, tubing, and fittings shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. EMT: Comply with ANSI C80.3 and UL 797.

D. FMC: Comply with UL 1; zinc-coated steel or aluminum.

E. GRC: Comply with ANSI C80.1 and UL 6.

F. IMC: Comply with ANSI C80.6 and UL 1242.

G. Fittings for Metal Conduit: Comply with NEMA FB 1 and UL 514B.
   1. Fittings for EMT:
      a. Material: Steel.
      b. Type: Set Screw.

2. Expansion Fittings: PVC or steel to match conduit type, complying with UL 651, rated for environmental conditions where installed, and including flexible external bonding jumper.

H. Joint Compound for GRC or IMC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

2.2 NONMETALLIC CONDUITS, TUBING, AND FITTINGS

A. Manufacturers: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

1. AFC Cable Systems; a division of Atkore International, Inc.
2. Arnco Corporation; a division of Dura-Line Holdings, Inc.
3. CANTEX Inc.
4. CertainTeed Corp.; Pipe & Plastics Group.
5. Condux International, Inc.
6. Electri-Flex Co.
7. Lamson & Sessions; Carlon Electrical Products.
8. Manhattan/CDT/Cole-Flex.
9. RACO; a Hubbell Company.
10. Thomas & Betts Corporation.

B. Listing and Labeling: Nonmetallic conduits, tubing, and fittings shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. ENT: NEMA TC 13.

D. LFNC: Comply with UL 1660.

E. RNC: Comply with NEMA TC 2 and UL 651, Type EPC-40-PVC, unless otherwise indicated.

F. Rigid HDPE: Comply with UL 651A.

G. Continuous HDPE: Comply with UL 651B.

H. Coilable HDPE: Preassembled with conductors or cables, and complying with ASTM D 3485.

I. Fittings for RNC: Comply with NEMA TC 3; match to conduit or tubing type and material.

J. Fittings for LFNC: Comply with UL 514B.

K. Solvents and Adhesives: As recommended by conduit manufacturer.

2.3 METAL WIREWAYS AND AUXILIARY GUTTERS

A. Manufacturers: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

1. Cooper B-Line, Inc.
2. Hoffman.
3. Square D; Schneider Electric.

B. Listing and Labeling: Metal wireways and auxiliary gutters shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Description: Sheet metal, complying with UL 870 and NEMA 250, Type 1 unless otherwise indicated, and sized according to NFPA 70.

1. Metal wireways installed outdoors shall be listed and labeled [Type 3R] [Type 4X] as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

D. Fittings and Accessories: Include covers, couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.

E. Wireway Covers: Hinged type unless otherwise indicated.

F. Finish: Manufacturer's standard enamel finish.

2.4 BOXES, ENCLOSURES, AND CABINETS

A. Manufacturers: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

1. Cooper Crouse-Hinds; Div. of Cooper Industries, Inc.
2. EGS/Appleton Electric.
3. Erickson Electrical Equipment Company.
4. Hoffman.
5. Hubbell Incorporated; Killark Electric Manufacturing Co. Division.
6. O-Z/Gedney; a unit of General Signal.
7. RACO; a Hubbell Company.
8. Scott Fetzer Co.; Adalet Division.
9. Spring City Electrical Manufacturing Company.
10. Thomas & Betts Corporation.
11. Walker Systems, Inc.; Wiremold Company (The).
12. Woodhead, Daniel Company; Woodhead Industries, Inc. Subsidiary.

B. General Requirements for Boxes, Enclosures, and Cabinets: Boxes, enclosures, and cabinets installed in wet locations shall be listed for use in wet locations.

C. Sheet Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.

D. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, ferrous alloy, Type FD, with gasketed cover.

E. Metal Floor Boxes:

1. Material: Cast or sheet metal.
2. Type: Fully adjustable.
3. Shape: Rectangular.
4. Listing and Labeling: Metal floor boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

F. Luminaire Outlet Boxes: Nonadjustable, designed for attachment of luminaire weighing 50 lbs. Outlet boxes designed for attachment of luminaires weighing more than 50 lbs. shall be listed and marked for the maximum allowable weight.

G. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.

H. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1 and UL 1773, cast aluminum with gasketed cover.

I. Box extensions used to accommodate new building finishes shall be of same material as recessed box.

J. Device Box Dimensions: 4 inches by 2-1/8 inches by 2-1/8 inches deep.

K. Gangable boxes are prohibited.

L. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250, Type 1 with continuous-hinge cover with flush latch unless otherwise indicated.

1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
2. Interior Panels: Steel; all sides finished with manufacturer's standard enamel.

M. Cabinets:

1. NEMA 250, Type 1 galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
2. Hinged door in front cover with flush latch and concealed hinge.
3. Key latch to match panelboards.
4. Metal barriers to separate wiring of different systems and voltage.
5. Accessory feet where required for freestanding equipment.

2.5 HANDHOLES AND BOXES FOR EXTERIOR UNDERGROUND WIRING

A. General Requirements for Handholes and Boxes:

1. Boxes and handholes for use in underground systems shall be designed and identified as defined in NFPA 70, for intended location and application.
2. Boxes installed in wet areas shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Polymer-Concrete Handholes and Boxes with Polymer-Concrete Cover: Molded of sand and aggregate, bound together with polymer resin, and reinforced with steel, fiberglass, or a combination of the two.

1. Manufacturers: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

a. Armorcast Products Company.
b. Carson Industries LLC.
c. CDR Systems Corporation.
d. NewBasis.

2. Standard: Comply with SCTE 77.
3. Configuration: Designed for flush burial with closed bottom unless otherwise indicated.

4. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure and handhole location.
5. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
6. Cover Legend: Molded lettering, "ELECTRIC".
7. Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.
8. Handholes 12 Inches Wide by 24 Inches Long and Larger: Have inserts for cable racks and pulling-in irons installed before concrete is poured.

C. Fiberglass Handholes and Boxes: Molded of fiberglass-reinforced polyester resin, with frame and covers of polymer concrete.

1. Manufacturers: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

   a. Armorcast Products Company.
   b. Carson Industries LLC.
   c. Christy Concrete Products.
   d. Synertech Moulded Products, Inc.; a division of Oldcastle Precast.

2. Standard: Comply with SCTE 77.
3. Color of Frame and Cover: Gray.
4. Configuration: Designed for flush burial with closed bottom unless otherwise indicated.
5. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure and handhole location.
6. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
7. Cover Legend: Molded lettering, "ELECTRIC".
8. Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.
9. Handholes 12 Inches Wide by 24 Inches Long and Larger: Have inserts for cable racks and pulling-in irons installed before concrete is poured.

2.6 SOURCE QUALITY CONTROL FOR UNDERGROUND ENCLOSURES

A. Handhole and Pull-Box Prototype Test: Test prototypes of handholes and boxes for compliance with SCTE 77. Strength tests shall be for specified tier ratings of products supplied.

1. Tests of materials shall be performed by an independent testing agency.
2. Strength tests of complete boxes and covers shall be by either an independent testing agency or manufacturer. A qualified registered professional engineer shall certify tests by manufacturer.
3. Testing machine pressure gages shall have current calibration certification complying with ISO 9000 and ISO 10012 and traceable to NIST standards.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

A. Outdoors: Apply raceway products as specified below unless otherwise indicated:

1. Exposed Conduit: GRC.
2. Concealed Conduit, Aboveground: GRC, IMC.
3. Underground Conduit: RNC, Type EPC-40-PVC,Type EPC-80-PVC, concrete encased].

4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFNC.
5. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R.
6. Application of Handholes and Boxes for Underground Wiring:
    a. Handholes and Pull Boxes in Driveway, Parking Lot, and Off-Roadway locations, subject to Occasional, Nondeliberate Loading by Heavy Vehicles: Polymer Concrete, SCTE 77, Tier 15 structural load rating.
    b. Handholes and Pull Boxes subject to Light Duty Pedestrian Traffic Only: Fiberglass reinforced polyester resin, structurally tested according to SCTE 77 with 3000-lbf vertical loading.

B. Indoors: Apply raceway products as specified below unless otherwise indicated:

1. Exposed, Not Subject to Physical Damage: EMT.
2. Exposed, Not Subject to Severe Physical Damage: EMT.
3. Exposed and Subject to Severe Physical Damage: GRC, IMC. Raceway locations include the following:
    a. Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.
    b. Mechanical rooms.
4. Corrosive Areas: PVC-Coated GRC.
5. Concealed in Ceilings and Interior Walls and Partitions: EMT.
6. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
7. Damp or Wet Locations: GRC, IMC.
8. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4X stainless steel in institutional and commercial kitchens and damp or wet locations.

C. Minimum Raceway Size: 3/4-inch trade size.

D. Raceway Fittings: Compatible with raceways and suitable for use and location.

1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.
2. EMT: Steel fittings. Comply with NEMA FB 2.10.
3. Flexible Conduit: Use only fittings listed for use with flexible conduit. Comply with NEMA FB 2.20.

E. Install surface raceways only where indicated on Drawings.

F. Do not install nonmetallic conduit where ambient temperature exceeds 120°F.

3.2 INSTALLATION

A. Comply with NECA 1 and NECA 101 for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NFPA 70 limitations for types of raceways allowed in specific occupancies and number of floors.

B. Keep raceways at least 6-inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.

C. Horizontal raceway and/or cable runs within walls are not acceptable. Raceway and cable runs shall not extend horizontally within walls further than the adjacent gap between framing studs. Any installation of horizontal raceway and/or cable runs within walls beyond the next adjacent framing stud will be completely removed and replaced at contractor's expense.

1. Exception: Receptacles, outlets and similar devices located partial height wall, below windows and similar openings, clerestory panel walls, and where structural conditions do not allow vertical access to tops of walls.

D. Complete raceway installation before starting conductor installation. Exceptions include pre-fabricated "whips" for final connection to furniture and luminaires.

E. Comply with requirements in Section 26 05 29 "Hangers and Supports for Electrical Systems" for hangers and supports.

F. Arrange stub-ups so curved portions of bends are not visible above finished slab.

G. Install no more than the equivalent of three 90-degree bends in any conduit run except for control wiring conduits, for which fewer bends are allowed. Support within 12-inches of changes in direction.

H. Conceal conduit and EMT within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.

I. Support conduit within 12-inches of enclosures to which attached.

J. Raceways Embedded in Slabs:

1. Run conduit larger than 1-inch trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support. Secure raceways to reinforcement at maximum 10-foot intervals.
2. Arrange raceways to cross building expansion joints at right angles with expansion fittings.
3. Arrange raceways to keep a minimum of 1-inch of concrete cover in all directions.
4. Do not embed threadless fittings in concrete unless specifically approved by Architect for each specific location.
5. Change from PVC to GRC before rising above floor.

K. Stub-ups to Above Recessed Ceilings:

1. Use EMT for raceways.
2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.

L. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.

M. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors including conductors smaller than No. 4 AWG.

N. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to 1-1/4-inch trade size and insulated throat metal bushings on 1-1/2-inch trade size and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits.

O. Install raceways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.

P. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to assure a continuous ground path.

Q. Cut conduit perpendicular to the length. For conduits 2-inch trade size and larger, use roll cutter or a guide to make cut straight and perpendicular to the length.

R. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12-inches of slack at each end of pull wire. Cap underground raceways designated as spare above grade alongside raceways in use.

S. Surface Raceways:

1. Install surface raceway with a minimum 2-inch radius control at bend points.
2. Secure surface raceway with screws or other anchor-type devices at intervals not exceeding 48-inches and with no less than two supports per straight raceway section. Support surface raceway according to manufacturer's written instructions. Tape and glue are not acceptable support methods.

T. Install raceway sealing fittings at accessible locations according to NFPA 70 and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings according to NFPA 70.

U. Install devices to seal raceway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal the interior of all raceways at the following points:

1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
2. Where an underground service raceway enters a building or structure.
3. Where otherwise required by NFPA 70.

V. Comply with manufacturer's written instructions for solvent welding RNC and fittings.

W. Expansion-Joint Fittings:

1. Install in each run of aboveground RNC that is located where environmental temperature change may exceed 30°F and that has straight-run length that exceeds 25 feet. Install in each run of aboveground GRC and EMT conduit that is located where environmental temperature change may exceed 100°F and that has straight-run length that exceeds 100 feet.
2. Install type and quantity of fittings that accommodate temperature change listed for each of the following locations:

   a. Outdoor Locations Not Exposed to Direct Sunlight: 125°F temperature change.
   b. Outdoor Locations Exposed to Direct Sunlight: 155°F temperature change.
   c. Indoor Spaces Connected with Outdoors without Physical Separation: 125°F temperature change.
   d. Attics: 135°F temperature change.

3. Install fitting(s) that provide expansion and contraction for at least 0.00041-inch per foot of length of straight run per degree F of temperature change for PVC conduits. Install

fitting(s) that provide expansion and contraction for at least 0.000078-inch per foot of length of straight run per degree F of temperature change for metal conduits.

4. Install expansion fittings at all locations where conduits cross building or structure expansion joints.
5. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.

X. Flexible Conduit Connections: Comply with NEMA RV 3. Use a maximum of 72-inches of flexible conduit for recessed and semi-recessed luminaires, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.

1. Use LFMC in damp or wet locations subject to severe physical damage.
2. Use LFMC or LFNC in damp or wet locations not subject to severe physical damage.

Y. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to center of box unless otherwise indicated.

Z. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall. Prepare block surfaces to provide a flat surface for a raintight connection between box and cover plate or supported equipment and box.

AA. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.

BB. Locate boxes so that cover or plate will not span different building finishes.

CC. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for the purpose.

DD. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.

EE. Set metal floor boxes level and flush with finished floor surface.

3.3 INSTALLATION OF UNDERGROUND HANDHOLES AND BOXES

A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting conduits to minimize bends and deflections required for proper entrances.

B. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1/2-inch sieve to No. 4 sieve and compacted to same density as adjacent undisturbed earth.

C. Elevation: In paved areas, set so cover surface will be flush with finished grade. Set covers of other enclosures 1-inch above finished grade.

D. Install handholes with bottom below frost line, First paragraph below requires Contractor to select hardware to install and support cable. Delete if cable support is not required. If required, revise paragraph to refer Contractor to Drawings, and show specific requirements on Drawings for each enclosure.

E. Install removable hardware, including pulling eyes, cable stanchions, cable arms, and insulators, as required for installation and support of cables and conductors and as indicated.

Select arm lengths to be long enough to provide spare space for future cables but short enough to preserve adequate working clearances in enclosure.

F. Field-cut openings for conduits according to enclosure manufacturer's written instructions. Cut wall of enclosure with a tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.

3.4 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 26 05 44 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

3.5 FIRESTOPPING

A. Install firestopping at penetrations of fire-rated floor and wall assemblies. Comply with requirements in Section 07 84 13 "Penetration Firestopping."

3.6 PROTECTION

A. Protect coatings, finishes, and cabinets from damage and deterioration.

1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
2. Repair damage to PVC coatings or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION 26 05 33

SECTION 26 05 43 - UNDERGROUND DUCTS AND RACEWAYS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Direct-buried conduit, ducts, and duct accessories.
2. Concrete-encased conduit, ducts, and duct accessories.
3. Handholes and boxes.
4. Manholes.

1.3 DEFINITIONS

A. Trafficways: Locations where vehicular or pedestrian traffic is a normal course of events.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include duct-bank materials, including separators and miscellaneous components.
2. Include ducts and conduits and their accessories, including elbows, end bells, bends, fittings, and solvent cement.
3. Include accessories for manholes, handholes, and boxes.
4. Include warning tape.

B. Shop Drawings:

1. Precast or Factory-Fabricated Underground Utility Structures:

a. Include plans, elevations, sections, details, attachments to other work, and accessories.
b. Include duct entry provisions, including locations and duct sizes.
c. Include reinforcement details.
d. Include frame and cover design and manhole frame support rings.
e. Include Ladder or Step details.
f. Include grounding details.
g. Include dimensioned locations of cable rack inserts, pulling-in and lifting irons, and sumps.
h. Include joint details.

2. Factory-Fabricated Handholes and Boxes Other Than Precast Concrete:

a. Include dimensioned plans, sections, and elevations, and fabrication and installation details.
b. Include duct entry provisions, including locations and duct sizes.
c. Include cover design.
d. Include grounding details.
e. Include dimensioned locations of cable rack inserts, and pulling-in and lifting irons.

1.5 INFORMATIONAL SUBMITTALS

A. Duct-Bank Coordination Drawings: Show duct profiles and coordination with other utilities and underground structures.

1. Include plans and sections, drawn to scale, and show bends and locations of expansion fittings.

B. Product Certificates: For concrete and steel used in precast concrete manholes and handholes, as required by ASTM C 858.

C. Source quality-control reports.

D. Field quality-control reports.

1.6 FIELD 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 Construction Manager no fewer than ten days in advance of proposed interruption of electrical service.
2. Do not proceed with interruption of electrical service without Construction Manager's written permission.

B. Ground Water: Assume ground-water level is 36-inches below ground surface unless a higher water table is noted on Drawings.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR DUCTS AND RACEWAYS

A. Comply with ANSI C2.

2.2 CONDUIT

A. Rigid Steel Conduit: Galvanized. Comply with ANSI C80.1.

B. RNC: NEMA TC 2, Type EPC-40-PVC and Type EPC-80-PVC, UL 651, with matching fittings by same manufacturer as the conduit, complying with NEMA TC 3 and UL 514B.

2.3 NONMETALLIC DUCTS AND DUCT ACCESSORIES

A. Underground Plastic Utilities Duct: NEMA TC 2, UL 651, ASTM F 512, Type EPC-80 and Type EPC-40, with matching fittings complying with NEMA TC 3 by same manufacturer as the duct.

B. Solvents and Adhesives: As recommended by conduit manufacturer.

C. Duct Accessories:

1. Duct Separators: Factory-fabricated rigid PVC interlocking spacers, sized for type and size of ducts with which used, and selected to provide minimum duct spacing indicated while supporting ducts during concreting or backfilling.
2. Warning Tape: Underground-line warning tape specified in Section 26 05 53 "Identification for Electrical Systems."

2.4 PRECAST CONCRETE HANDHOLES AND BOXES

A. Comply with ASTM C 858 for design and manufacturing processes.

B. Description: Factory-fabricated, reinforced-concrete, monolithically poured walls and bottom unless open-bottom enclosures are indicated. Frame and cover shall form top of enclosure and shall have load rating consistent with that of handhole or box.

1. Frame and Cover: Weatherproof cast-iron frame, with cast-iron cover with recessed cover hook eyes and tamper-resistant, captive, cover-securing bolts.
2. Frame and Cover: Weatherproof steel frame, with steel cover with recessed cover hook eyes and tamper-resistant, captive, cover-securing bolts.
3. Frame and Cover: Weatherproof steel frame, with hinged steel access door assembly with tamper-resistant, captive, cover-securing bolts.

   a. Cover Hinges: Concealed, with hold-open ratchet assembly.
   b. Cover Handle: Recessed.

4. Frame and Cover: Weatherproof aluminum frame with hinged aluminum access door assembly with tamper-resistant, captive, cover-securing bolts.

   a. Cover Hinges: Concealed, with hold-open ratchet assembly.
   b. Cover Handle: Recessed.

5. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
6. Cover Legend: Molded lettering, as indicated for each service.
7. Configuration: Units shall be designed for flush burial and have closed bottom unless otherwise indicated.
8. Extensions and Slabs: Designed to mate with bottom of enclosure. Same material as enclosure.

   a. Extension shall provide increased depth of 12-inches.
   b. Slab: Same dimensions as bottom of enclosure, and arranged to provide closure.

9. Joint Sealant: Asphaltic-butyl material with adhesion, cohesion, flexibility, and durability properties necessary to withstand maximum hydrostatic pressures at the installation location with the ground-water level at grade.

10. Windows: Precast openings in walls, arranged to match dimensions and elevations of approaching ducts and duct banks, plus an additional 12-inches vertically and horizontally to accommodate alignment variations.

    a. Windows shall be located no less than 6-inches from interior surfaces of walls, floors, or frames and covers of handholes, but close enough to corners to facilitate racking of cables on walls.
    b. Window opening shall have cast-in-place, welded-wire fabric reinforcement for field cutting and bending to tie in to concrete envelopes of duct banks.
    c. Window openings shall be framed with at least two additional No. 3 steel reinforcing bars in concrete around each opening.

11. Duct Entrances in Handhole Walls: Cast end-bell or duct-terminating fitting in wall for each entering duct.

    a. Type and size shall match fittings to duct or conduit to be terminated.
    b. Fittings shall align with elevations of approaching ducts and be located near interior corners of handholes to facilitate racking of cable.

12. Handholes 12-inches wide by 24-inches long and larger shall have inserts for cable racks and pulling-in irons installed before concrete is poured.

2.5 HANDHOLES AND BOXES OTHER THAN PRECAST CONCRETE

A. General Requirements for Handholes and Boxes: Comply with SCTE 77. Comply with tier requirements in "Underground Enclosure Application" Article.

1. Color: Gray.
2. Configuration: Units shall be designed for flush burial and have closed bottom unless otherwise indicated.
3. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure.
4. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
5. Cover Legend: Molded lettering, as indicated for each service.
6. Direct-Buried Wiring Entrance Provisions: Knockouts equipped with insulated bushings or end-bell fittings, selected to suit box material, sized for wiring indicated, and arranged for secure, fixed installation in enclosure wall.
7. Duct Entrance Provisions: Duct-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.
8. Handholes 12-inches wide by 24-inches long and larger shall have factory-installed inserts for cable racks and pulling-in irons.

B. Polymer Concrete Handholes and Boxes with Polymer Concrete Cover: Molded of sand and aggregate, bound together with a polymer resin, and reinforced with steel or fiberglass or a combination of the two.

C. Fiberglass Handholes and Boxes with Polymer Concrete Frame and Cover: Sheet-molded, fiberglass-reinforced, polyester resin enclosure joined to polymer concrete top ring or frame.

D. Fiberglass Handholes and Boxes: Molded of fiberglass-reinforced polyester resin, with covers made of **polymer concrete**

E. High-Density Plastic Boxes: Injection molded of high-density polyethylene or copolymer-polypropylene. Cover shall be made of **polymer concrete**

2.6 PRECAST MANHOLES

A. Comply with ASTM C 858.

B. Structural Design Loading: Comply with requirements in "Underground Enclosure Application" Article.

C. Precast Manholes: One-piece units and units with interlocking mating sections, complete with accessories, hardware, and features.

D. Windows: Precast openings in walls, arranged to match dimensions and elevations of approaching ducts and duct banks, plus an additional 12-inches vertically and horizontally to accommodate alignment variations.

1. Windows shall be located no less than 6-inches from interior surfaces of walls, floors, or roofs of manholes, but close enough to corners to facilitate racking of cables on walls.
2. Window opening shall have cast-in-place, welded-wire fabric reinforcement for field cutting and bending to tie in to concrete envelopes of duct banks.
3. Window openings shall be framed with at least two additional No. 3 steel reinforcing bars in concrete around each opening.

E. Duct Entrances in Manhole Walls: Cast end-bell or duct-terminating fitting in wall for each entering duct.

1. Type and size shall match fittings to duct or conduit to be terminated.
2. Fittings shall align with elevations of approaching ducts and be located near interior corners of manholes to facilitate racking of cable.

F. Concrete Knockout Panels: 1-1/2-inches to 2-inches thick, for future conduit entrance and sleeve for ground rod.

G. Ground Rod Sleeve: Provide a 3-inch PVC conduit sleeve in manhole floors 2-inches from the wall adjacent to, but not underneath, the ducts routed from the facility.

H. Joint Sealant: Asphaltic-butyl material with adhesion, cohesion, flexibility, and durability properties necessary to withstand maximum hydrostatic pressures at the installation location with the ground-water level at grade.

2.7 CAST-IN-PLACE MANHOLES

A. Description: Underground utility structures, constructed in place, complete with accessories, hardware, and features. Include concrete knockout panels for conduit entrance and sleeve for ground rod.

B. Materials: Comply with ASTM C 858 and with Section 03 30 00 "Cast-in-Place Concrete."

C. Structural Design Loading: As specified in "Underground Enclosure Application" Article.

2.8 UTILITY STRUCTURE ACCESSORIES

A. Manhole Frames, Covers, and Chimney Components: Comply with structural design loading specified for manhole.

1. Frame and Cover: Weatherproof, gray cast iron complying with ASTM A 48/A 48M, Class 30B with milled cover-to-frame bearing surfaces; diameter, 29 inches.

    a. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
    b. Special Covers: Recess in face of cover designed to accept finish material in paved areas.

2. Cover Legend: Cast in. Selected to suit system.

    a. Legend: "ELECTRIC-LV" for duct systems with power wires and cables for systems operating at 600 V and less.
    b. Legend: "ELECTRIC-HV" for duct systems with medium-voltage cables.

3. Manhole Chimney Components: Precast concrete rings with dimensions matched to those of roof opening.

    a. Mortar for Chimney Ring and Frame and Cover Joints: Comply with ASTM C 270, Type M, except for quantities less than 2.0 cu. ft. where packaged mix complying with ASTM C 387, Type M, may be used.
    b. Seal joints watertight using preformed plastic or rubber conforming to ASTM C 990. Install sealing material according to the sealant manufacturers' printed instructions.

B. Manhole Sump Frame and Grate: ASTM A 48/A 48M, Class 30B, gray cast iron.

C. Pulling Eyes in Concrete Walls: Eyebolt with reinforcing-bar fastening insert, 2-inch diameter eye, and 1-by-4-inch bolt.

    1. Working Load Embedded in 6-Inch, 4000-psi Concrete: 13,000-lbf minimum tension.

D. Pulling Eyes in Nonconcrete Walls: Eyebolt with reinforced fastening, 1-1/4-inch diameter eye, rated 2500-lbf minimum tension.

E. Pulling-In and Lifting Irons in Concrete Floors: 7/8-inch diameter, hot-dip galvanized, bent steel rod; stress relieved after forming; and fastened to reinforcing rod. Exposed triangular opening.

    1. Ultimate Yield Strength: 40,000-lbf shear and 60,000-lbf tension.

F. Bolting Inserts for Concrete Utility Structure Cable Racks and Other Attachments: Flared, threaded inserts of noncorrosive, chemical-resistant, nonconductive thermoplastic material; 1/2-inch ID by 2-3/4 inches deep, flared to 1-1/4 inches minimum at base.

    1. Tested Ultimate Pullout Strength: 12,000 lbf minimum.

G. Ground Rod Sleeve: 3-inch, PVC conduit sleeve in manhole floors 2-inches from the wall adjacent to, but not underneath, the ducts routed from the facility.

H. Expansion Anchors for Installation after Concrete Is Cast: Zinc-plated, carbon-steel-wedge type with stainless-steel expander clip with 1/2-inch bolt, 5300-lbf rated pullout strength, and minimum 6800-lbf rated shear strength.

I. Cable Rack Assembly: Steel, hot-dip galvanized, except insulators.

    1. Stanchions: T-section or channel; 2-1/4-inch nominal size; punched with 14 holes on 1-1/2-inch centers for cable-arm attachment.

2. Arms: 1-1/2-inches wide, lengths ranging from 3-inches with 450-lb minimum capacity to 18-inches with 250-lb minimum capacity. Arms shall have slots along full length for cable ties and be arranged for secure mounting in horizontal position at any vertical location on stanchions.
3. Insulators: High-glaze, wet-process porcelain arranged for mounting on cable arms.

J. Cable Rack Assembly: Nonmetallic. Components fabricated from nonconductive, fiberglass-reinforced polymer.

1. Stanchions: Nominal 36-inches high by 4-inches wide, with minimum of nine holes for arm attachment.
2. Arms: Arranged for secure, drop-in attachment in horizontal position at any location on cable stanchions, and capable of being locked in position. Arms shall be available in lengths ranging from 3-inches with 450-lb minimum capacity to 20-inches with 250-lb minimum capacity. Top of arm shall be nominally 4-inches wide, and arm shall have slots along full length for cable ties.

K. Duct-Sealing Compound: Non-hardening, safe for contact with human skin, not deleterious to cable insulation, and workable at temperatures as low as 35°F. Capable of withstanding temperature of 300°F without slump and adhering to clean surfaces of plastic ducts, metallic conduits, conduit coatings, concrete, masonry, lead, cable sheaths, cable jackets, insulation materials, and common metals.

L. Fixed Manhole Ladders: Arranged for attachment to roof or wall, and floor of manhole. Ladder and mounting brackets and braces shall be fabricated from nonconductive, structural-grade, fiberglass-reinforced resin.

M. Portable Manhole Ladders: UL-listed, heavy-duty fiberglass specifically designed for portable use for access to electrical manholes. Minimum length equal to distance from deepest manhole floor to grade plus 36-inches. One required.

N. Cover Hooks: Heavy duty, designed for lifts 60 lbf and greater. Two required.

2.9 SOURCE QUALITY CONTROL

A. Test and inspect precast concrete utility structures according to ASTM C 1037.

B. Nonconcrete Handhole and Pull-Box Prototype Test: Test prototypes of manholes and boxes for compliance with SCTE 77. Strength tests shall be for specified tier ratings of products supplied.

1. Tests of materials shall be performed by an independent testing agency.
2. Strength tests of complete boxes and covers shall be by either an independent testing agency or manufacturer. A qualified registered professional engineer shall certify tests by manufacturer.
3. Testing machine pressure gages shall have current calibration certification, complying with ISO 9000 and ISO 10012, and traceable to NIST standards.

PART 3 - EXECUTION

3.1 PREPARATION

A. Coordinate layout and installation of ducts, manholes, handholes, and boxes with final arrangement of other utilities, site grading, and surface features as determined in the field. Notify Architect if there is a conflict between areas of excavation and existing structures or archaeological sites to remain.

B. Coordinate elevations of ducts and duct-bank entrances into manholes, handholes, and boxes with final locations and profiles of ducts and duct banks, as determined by coordination with other utilities, underground obstructions, and surface features. Revise locations and elevations as required to suit field conditions and to ensure that duct runs drain to manholes and handholes, and as approved by Architect.

3.2 UNDERGROUND DUCT APPLICATION

A. Ducts for Electrical Cables More than 600 V: RNC, NEMA Type EPC-80, in concrete-encased duct bank unless otherwise indicated.

B. Ducts for Electrical Feeders 600 V and Less: RNC, NEMA Type EPC-40, in concrete-encased duct bank unless otherwise indicated.

C. Ducts for Electrical Feeders 600 V and Less: RNC, NEMA Type EPC-80, in direct-buried duct bank unless otherwise indicated.

D. Ducts for Electrical Branch Circuits: RNC, NEMA Type EPC-40, in direct-buried duct bank unless otherwise indicated.

E. Underground Ducts Crossing Driveways, Roadways and Railroads: RNC, NEMA Type EPC-40-PVC, encased in reinforced concrete.

3.3 UNDERGROUND ENCLOSURE APPLICATION

A. Handholes and Boxes for 600 V and Less:

1. Units in Roadways and Other Deliberate Traffic Paths: Precast concrete. AASHTO HB 17, **H-10** structural load rating.
2. Units in Driveway, Parking Lot, and Off-Roadway Locations, Subject to Occasional, Nondeliberate Loading by Heavy Vehicles: **Precast concrete, AASHTO HB 17, H-20** structural load rating.
3. Units in Sidewalk and Similar Applications with a Safety Factor for Nondeliberate Loading by Vehicles: **Precast concrete, AASHTO HB 17, H-10** structural load rating.
4. Units Subject to Light-Duty Pedestrian Traffic Only: **Fiberglass-reinforced polyester resin**] [**High-density plastic**, structurally tested according to SCTE 77 with 3000-lbf (13 345-N) vertical loading.
5. Cover design load shall not exceed the design load of the handhole or box.

B. Manholes: **Precast** concrete.

1. Units Located in Roadways and Other Deliberate Traffic Paths by Heavy or Medium Vehicles: H-20 structural load rating according to AASHTO HB 17.

2. Units Not Located in Deliberate Traffic Paths by Heavy or Medium Vehicles: H-10 load rating according to AASHTO HB 17.

3.4 DUCT INSTALLATION

A. Install ducts according to NEMA TCB 2.

B. Slope: Pitch ducts a minimum slope of 1:300 down toward manholes and handholes and away from buildings and equipment. Slope ducts from a high point in runs between two manholes, to drain in both directions.

C. Curves and Bends: Use 5-degree angle couplings for small changes in direction. Use manufactured long sweep bends with a minimum radius of **48 inches (1200 mm)** both horizontally and vertically, at other locations unless otherwise indicated.

D. Joints: Use solvent-cemented joints in ducts and fittings and make watertight according to manufacturer's written instructions. Stagger couplings so those of adjacent ducts do not lie in same plane.

E. Installation Adjacent to High-Temperature Steam Lines: Where duct banks are installed parallel to underground steam lines, perform calculations showing the duct bank will not be subject to environmental temperatures above 40°C. Where environmental temperatures are calculated to rise above 40°C, and anywhere the duct bank crosses above an underground steam line, install insulation blankets listed for direct burial to isolate the duct bank from the steam line.

F. Duct Entrances to Manholes and Concrete and Polymer Concrete Handholes: Use end bells, spaced approximately 10-inches o.c. for 5-inch ducts, and vary proportionately for other duct sizes.

1. Begin change from regular spacing to end-bell spacing 10-feet from the end bell without reducing duct line slope and without forming a trap in the line.
2. Direct-Buried Duct Banks: Install an expansion and deflection fitting in each conduit in the area of disturbed earth adjacent to manhole or handhole. Install an expansion fitting near the center of all straight line direct-buried duct banks with calculated expansion of more than 3/4-inch.
3. Grout end bells into structure walls from both sides to provide watertight entrances.

G. Building Wall Penetrations: Make a transition from underground duct to rigid steel conduit at least 10-feet outside the building wall, without reducing duct line slope away from the building, and without forming a trap in the line. Use fittings manufactured for duct-to-conduit transition. Install conduit penetrations of building walls as specified in Section 26 05 44 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

H. Sealing: Provide temporary closure at terminations of ducts that have cables pulled. Seal spare ducts at terminations. Use sealing compound and plugs to withstand at least 15-psig hydrostatic pressure.

I. Pulling Cord: Install 200-lbf test nylon cord in empty ducts.

J. Concrete-Encased Ducts: Support ducts on duct separators.

1. Excavate trench bottom to provide firm and uniform support for duct bank. Prepare trench bottoms as specified in Section 31 20 00 "Earth Moving" for pipes less than 6-inches in nominal diameter.

2. Width: Excavate trench 12-inches wider than duct bank on each side.
3. Width: Excavate trench 3-inches wider than duct bank on each side.
4. Depth: Install top of duct bank at least 24-inches below finished grade in areas not subject to deliberate traffic, and at least 30-inches below finished grade in deliberate traffic paths for vehicles unless otherwise indicated.
5. Support ducts on duct separators coordinated with duct size, duct spacing, and outdoor temperature.
6. Separator Installation: Space separators close enough to prevent sagging and deforming of ducts, with not less than five spacers per 20-feet of duct. Secure separators to earth and to ducts to prevent floating during concreting. Stagger separators approximately 6-inches between tiers. Tie entire assembly together using fabric straps; do not use tie wires or reinforcing steel that may form conductive or magnetic loops around ducts or duct groups.
7. Minimum Space between Ducts: 3-inches between ducts and exterior envelope wall, 2-inches between ducts for like services, and 4-inches between power and signal ducts.
8. Elbows: Use manufactured duct elbows for stub-ups at poles and equipment, at building entrances through floor, and at changes of direction in duct run unless otherwise indicated. Extend concrete encasement throughout length of elbow.
9. Elbows: Use manufactured rigid steel conduit elbows for stub-ups at poles and equipment, at building entrances through floor, and at changes of direction in duct run.

    a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3-inches of concrete.
    b. Stub-Ups to Equipment: For equipment mounted on outdoor concrete bases, extend steel conduit horizontally a minimum of 60-inches from edge of base. Install insulated grounding bushings on terminations at equipment.

10. Reinforcement: Reinforce concrete-encased duct banks where they cross disturbed earth and where indicated. Arrange reinforcing rods and ties without forming conductive or magnetic loops around ducts or duct groups.
11. Forms: Use walls of trench to form side walls of duct bank where soil is self-supporting and concrete envelope can be poured without soil inclusions; otherwise, use forms.
12. Concrete Cover: Install a minimum of 3-inches of concrete cover at top and bottom, and a minimum of 2-inches on each side of duct bank.
13. Concreting Sequence: Pour each run of envelope between manholes or other terminations in one continuous operation.

    a. Start at one end and finish at the other, allowing for expansion and contraction of ducts as their temperature changes during and after the pour. Use expansion fittings installed according to manufacturer's written recommendations, or use other specific measures to prevent expansion-contraction damage.
    b. If more than one pour is necessary, terminate each pour in a vertical plane and install 3/4-inch reinforcing-rod dowels extending a minimum of 18-inches into concrete on both sides of joint near corners of envelope.

14. Pouring Concrete: Comply with requirements in "Concrete Placement" Article in Section 03 30 00 "Cast-in-Place Concrete." Place concrete carefully during pours to prevent voids under and between conduits and at exterior surface of envelope. Do not allow a heavy mass of concrete to fall directly onto ducts. Allow concrete to flow to center of bank and rise up in middle, uniformly filling all open spaces. Do not use power-driven agitating equipment unless specifically designed for duct-bank application.

K. Direct-Buried Duct Banks:

1. Excavate trench bottom to provide firm and uniform support for duct bank. Comply with requirements in Section 31 20 00 "Earth Moving" for preparation of trench bottoms for pipes less than 6-inches in nominal diameter.
2. Support ducts on duct separators coordinated with duct size, duct spacing, and outdoor temperature.
3. Space separators close enough to prevent sagging and deforming of ducts, with not less than five spacers per 20-feet of duct. Secure separators to earth and to ducts to prevent displacement during backfill and yet permit linear duct movement due to expansion and contraction as temperature changes. Stagger spacers approximately 6-inches between tiers.
4. Depth: Install top of duct bank at least 36-inches below finished grade unless otherwise indicated.
5. Set elevation of bottom of duct bank below frost line.
6. Install ducts with a minimum of 3-inches between ducts for like services and 6-inches between power and signal ducts.
7. Elbows: Install manufactured duct elbows for stub-ups at poles and equipment, at building entrances through floor, and at changes of direction in duct run unless otherwise indicated. Encase elbows for stub-up ducts throughout length of elbow.
8. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment, at building entrances through floor, and at changes of direction in duct run.

    a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3-inches of concrete.
    b. For equipment mounted on outdoor concrete bases, extend steel conduit horizontally a minimum of 60-inches from edge of equipment pad or foundation. Install insulated grounding bushings on terminations at equipment.

9. After installing first tier of ducts, backfill and compact. Start at tie-in point and work toward end of duct run, leaving ducts at end of run free to move with expansion and contraction as temperature changes during this process. Repeat procedure after placing each tier. After placing last tier, hand place backfill to 4-inches over ducts and hand tamp. Firmly tamp backfill around ducts to provide maximum supporting strength. Use hand tamper only. After placing controlled backfill over final tier, make final duct connections at end of run and complete backfilling with normal compaction. Comply with requirements in Section 31 20 00 "Earth Moving" for installation of backfill materials.

    a. Place minimum 3-inches of sand as a bed for duct bank. Place sand to a minimum of 6-inches above top level of duct bank.
    b. Place minimum 6-inches of engineered fill above concrete encasement of duct bank.

L. Warning Tape: Bury warning tape approximately 12-inches above all concrete-encased ducts and duct banks. Align tape parallel to and within 3-inches of centerline of ductbank. Provide an additional warning tape for each 12-inch increment of ductbank width over a nominal 18-inches. Space additional tapes 12-inches apart, horizontally.

3.5 INSTALLATION OF CONCRETE [MANHOLES,] [HANDHOLES,] AND BOXES

A. Cast-in-Place Manhole Installation:

1. Finish interior surfaces with a smooth-troweled finish.
2. Windows for Future Duct Connections: Form and pour concrete knockout panels 1-1/2 to 2-inches thick, arranged as indicated.

3. Comply with requirements in Section 03 30 00 "Cast-in-Place Concrete" for cast-in-place concrete, formwork, and reinforcement.

B. Precast Concrete Handhole and Manhole Installation:

1. Comply with ASTM C 891 unless otherwise indicated.
2. Install units level and plumb and with orientation and depth coordinated with connecting ducts, to minimize bends and deflections required for proper entrances.
3. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1-inch sieve to No. 4 sieve and compacted to same density as adjacent undisturbed earth.

C. Elevations:

1. Manhole Roof: Install with rooftop at least 15-inches below finished grade.
2. Manhole Frame: In paved areas and trafficways, set frames flush with finished grade. Set other manhole frames 1-inch above finished grade.
3. Handhole Covers: In paved areas and trafficways, set surface flush with finished grade. Set covers of other handholes 1-inch above finished grade.
4. Where indicated, cast handhole cover frame integrally with handhole structure.

D. Drainage: Install drains in bottom of manholes where indicated. Coordinate with drainage provisions indicated.

E. Manhole Access: Circular opening in manhole roof; sized to match cover size.

1. Manholes with Fixed Ladders: Offset access opening from manhole centerlines to align with ladder.
2. Install chimney, constructed of precast concrete collars and rings, to support cast-iron frame to connect cover with manhole roof opening. Provide moisture-tight masonry joints and waterproof grouting for frame to chimney.

F. Waterproofing: Apply waterproofing to exterior surfaces of manholes and handholes after concrete has cured at least three days. After ducts have been connected and grouted, and before backfilling, waterproof joints and connections, and touch up abrasions and scars. Waterproof exterior of manhole chimneys after mortar has cured at least three days.

G. Dampproofing: Apply dampproofing to exterior surfaces of manholes and handholes after concrete has cured at least three days. Dampproofing materials and installation are specified in Section 07 11 13 "Bituminous Dampproofing." After ducts are connected and grouted, and before backfilling, dampproof joints and connections, and touch up abrasions and scars. Dampproof exterior of manhole chimneys after mortar has cured at least three days.

H. Hardware: Install removable hardware, including pulling eyes, cable stanchions, **and** cable arms, **and insulators,** as required for installation and support of cables and conductors and as indicated.

I. Fixed Manhole Ladders: Arrange to provide for safe entry with maximum clearance from cables and other items in manholes.

J. Field-Installed Bolting Anchors in Manholes and Concrete Handholes: Do not drill deeper than 3-7/8-inches for manholes and 2-inches for handholes, for anchor bolts installed in the field. Use a minimum of two anchors for each cable stanchion.

3.6 INSTALLATION OF HANDHOLES AND BOXES OTHER THAN PRECAST CONCRETE

A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting ducts, to minimize bends and deflections required for proper entrances. Use box extension if required to match depths of ducts, and seal joint between box and extension as recommended by manufacturer.

B. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1/2-inch sieve to No. 4 sieve and compacted to same density as adjacent undisturbed earth.

C. Elevation: In paved areas and trafficways, set cover flush with finished grade. Set covers of other handholes 1-inch above finished grade.

D. Install removable hardware, including pulling eyes, cable stanchions, cable arms, and insulators, as required for installation and support of cables and conductors and as indicated. Select arm lengths to be long enough to provide spare space for future cables, but short enough to preserve adequate working clearances in enclosure.

E. Field cut openings for ducts and conduits according to enclosure manufacturer's written instructions. Cut wall of enclosure with a tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.

F. For enclosures installed in asphalt paving and subject to occasional, non-deliberate, heavy-vehicle loading, form and pour a concrete ring encircling, and in contact with, enclosure and with top surface screeded to top of box cover frame. Bottom of ring shall rest on compacted earth.

1. Concrete: 3000 psi, 28-day strength,
2. Dimensions: 10 inches wide by 12 inches deep.

3.7 GROUNDING

A. Ground underground ducts and utility structures according to Section 26 05 26 "Grounding and Bonding for Electrical Systems."

3.8 FIELD QUALITY CONTROL

A. Perform the following tests and inspections and prepare test reports:

1. Demonstrate capability and compliance with requirements on completion of installation of underground ducts and utility structures.
2. Pull solid aluminum or wood test mandrel through duct to prove joint integrity and adequate bend radii, and test for out-of-round duct. Provide a minimum 6-inch long mandrel equal to 80% fill of duct. If obstructions are indicated, remove obstructions and retest.
3. Test [manhole] [and] [handhole] grounding to ensure electrical continuity of grounding and bonding connections. Measure and report ground resistance as specified in Section 26 05 26 "Grounding and Bonding for Electrical Systems."

B. Correct deficiencies and retest as specified above to demonstrate compliance.

3.9 CLEANING

A. Pull leather-washer-type duct cleaner, with graduated washer sizes, through full length of ducts. Follow with rubber duct swab for final cleaning and to assist in spreading lubricant throughout ducts.

B. Clean internal surfaces of manholes, including sump. Remove foreign material.

END OF SECTION 26 05 43

SECTION 26 05 44 - SLEEVES AND SLEEVE SEALS FOR ELECTRICAL RACEWAYS AND CABLING

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. Sleeves for raceway and cable penetration of non-fire-rated construction walls and floors.
2. Sleeve-seal systems.
3. Sleeve-seal fittings.
4. Grout.
5. Silicone sealants.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 SLEEVES

A. Wall Sleeves:

1. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, plain ends.
2. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.

B. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies: Galvanized-steel sheet; 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint, with tabs for screw-fastening the sleeve to the board.

C. PVC Pipe Sleeves: ASTM D 1785, Schedule 40.

D. Molded PVC Sleeves: With nailing flange for attaching to wooden forms.

E. Molded PE or PP Sleeves: Removable, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.

F. Sleeves for Rectangular Openings:

1. Material: Galvanized sheet steel.

2. Minimum Metal Thickness:

   a. For sleeve cross-section rectangle perimeter less than 50-inches and with no side larger than 16-inches, thickness shall be 0.052-inch.
   b. For sleeve cross-section rectangle perimeter 50-inches or more and one or more sides larger than 16-inches, thickness shall be 0.138-inch.

2.2 SLEEVE-SEAL SYSTEMS

A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.

1. Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. Advance Products & Systems, Inc.
   b. Calpico, Inc.
   c. Metraflex Co.
   d. Pipeline Seal and Insulator, Inc.

2. Sealing Elements: EPDM rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
3. 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.
5. Sleeve-Seal Fittings: Manufactured plastic, sleeve-type, waterstop assembly made for embedding in concrete slab or wall. Unit shall have plastic or rubber waterstop collar with center opening to match piping OD.

2.3 GROUT

A. Description: Non-shrink; recommended for interior and exterior sealing openings in non-fire-rated walls or floors.

B. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.

C. Design Mix: 5000-psi, 28-day compressive strength.

D. Packaging: Premixed and factory packaged.

2.4 SILICONE SEALANTS

A. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants of grade indicated below.

1. Grade: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces that are not fire rated.

B. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, non-shrinking foam.

PART 3 - EXECUTION

3.1 SLEEVE INSTALLATION FOR NON-FIRE-RATED ELECTRICAL PENETRATIONS

A. Comply with NECA 1.

B. Comply with NEMA VE 2 for cable tray and cable penetrations.

C. Sleeves for Conduits Penetrating Above-Grade Non-Fire-Rated Concrete and Masonry-Unit Floors and Walls:

1. Interior Penetrations of Non-Fire-Rated Walls and Floors:

a. Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint.
b. Seal space outside of sleeves with mortar or grout. Pack sealing material solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect material while curing.

2. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
3. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and raceway or cable unless sleeve seal is to be installed.
4. Install sleeves for wall penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of walls. Cut sleeves to length for mounting flush with both surfaces of walls. Deburr after cutting.
5. Install sleeves for floor penetrations. Extend sleeves installed in floors 2-inches above finished floor level. Install sleeves during erection of floors.

D. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies:

1. Use circular metal sleeves unless penetration arrangement requires rectangular sleeved opening.
2. Seal space outside of sleeves with approved joint compound for gypsum board assemblies.

E. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.

F. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

G. Underground, Exterior-Wall and Floor Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch annular clear space between raceway or cable and sleeve for installing sleeve-seal system.

3.2 SLEEVE-SEAL-SYSTEM INSTALLATION

A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at raceway entries into building.

B. Install type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical

sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.3 SLEEVE-SEAL-FITTING INSTALLATION

A. Install sleeve-seal fittings in new walls and slabs as they are constructed.

B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange to be centered in concrete slab or wall.

C. Secure nailing flanges to concrete forms.

D. Using grout, seal the space around outside of sleeve-seal fittings.

END OF SECTION 26 05 44

SECTION 26 05 53 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Color and legend requirements for raceways, conductors, and warning labels and signs.
2. Labels.
3. Bands.
4. Tapes and stencils.
5. Tags.
6. Signs.
7. Cable ties.
8. Paint for identification.
9. Fasteners for labels and signs.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for electrical identification products.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Comply with ASME A13.1 and IEEE C2.

B. Comply with NFPA 70.

C. Comply with 29 CFR 1910.144 and 29 CFR 1910.145.

D. Comply with ANSI Z535.4 for safety signs and labels.

E. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.

F. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.

1. Temperature Change: 120°F, ambient; 180°F, material surfaces.

2.2 COLOR AND LEGEND REQUIREMENTS

A. Raceways and Cables Carrying Circuits at 600 V or Less:

1. Black letters on an orange field.
2. Legend: Indicate voltage and system or service type.

B. Color-Coding for Phase and Voltage-Level Identification, 600 V or Less: Use colors listed below for ungrounded service, feeder and branch-circuit conductors.

1. Color shall be factory applied, or field applied for sizes larger than No. 8 AWG if authorities having jurisdiction permit.
2. Colors for 208/120-V Circuits:

a. Phase A: Black.
b. Phase B: Red.
c. Phase C: Blue.

3. Colors for 240-V Circuits:

a. Phase A: Black.
b. Phase B: Red.

4. Colors for 480/277-V Circuits:

a. Phase A: Brown.
b. Phase B: Orange.
c. Phase C: Yellow.

5. Color for Neutral: White or gray, dependent upon the voltage system.
6. Color for Equipment Grounds: Green or Bare copper.

C. Warning Label Colors:

1. Identify system voltage with black letters on an orange background.

D. Warning labels and signs shall include, but are not limited to, the following legends:
1. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36-INCHES."

E. Equipment Identification Labels:

1. Black letters on a white field.

2.3 LABELS

A. Vinyl Wraparound Labels: Preprinted, flexible labels laminated with a clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing label ends.

B. Snap-around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeves, with diameters sized to suit diameters and that stay in place by gripping action.

C. Self-Adhesive Wraparound Labels: Preprinted, 3-mil thick, vinyl flexible label with acrylic pressure-sensitive adhesive.

1. Self-Lamination: Clear; UV-, weather- and chemical-resistant; self-laminating, protective shield over the legend. Labels sized such that the clear shield overlaps the entire printed legend.
2. Marker for Labels: Machine-printed, permanent, waterproof, black ink recommended by printer manufacturer.

D. Self-Adhesive Labels: Vinyl, thermal, transfer-printed, 3-mil thick, multicolor, weather- and UV-resistant, pressure-sensitive adhesive labels, configured for intended use and location.

1. Minimum Nominal Size:

a. 1-1/2 by 6 inches for raceway and conductors.
b. 3-1/2 by 5 inches for equipment.
c. As required by authorities having jurisdiction.

2.4 BANDS

A. Snap-around, Color-Coding Bands: Slit, pretensioned, flexible, solid-colored acrylic sleeves, 2-inches long, with diameters sized to suit diameters and that stay in place by gripping action.

2.5 TAPES AND STENCILS

A. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.

B. Self-Adhesive Vinyl Tape: Colored, heavy duty, waterproof, fade resistant; not less than 3-mils thick by 1 to 2 inches wide; compounded for outdoor use.

C. Underground-Line Warning Tape:

1. Tape:

a. Recommended by manufacturer for the method of installation and suitable to identify and locate underground electrical utility lines.
b. Printing on tape shall be permanent and shall not be damaged by burial operations.
c. Tape material and ink shall be chemically inert and not subject to degradation when exposed to acids, alkalis, and other destructive substances commonly found in soils.

2. Color and Printing:

a. Comply with ANSI Z535.1, ANSI Z535.2, ANSI Z535.3, ANSI Z535.4, and ANSI Z535.5.
b. Inscriptions for Red-Colored Tapes: "ELECTRIC LINE, HIGH VOLTAGE".
c. Inscriptions for Orange-Colored Tapes: "TELEPHONE CABLE, CATV CABLE, COMMUNICATIONS CABLE, OPTICAL FIBER CABLE".

D. Stenciled Legend: In nonfading, waterproof, black ink. Minimum letter height shall be 1-inch.

2.6 TAGS

A. Metal Tags: Brass or aluminum, 2 by 2 by 0.05 inch, with stamped legend, punched for use with self-locking cable tie fastener.

B. Nonmetallic Preprinted Tags: Polyethylene tags, 0.023-inch thick, color-coded for phase and voltage level, with factory printed permanent designations; punched for use with self-locking cable tie fastener.

2.7 SIGNS

A. Baked-Enamel Signs:

1. Preprinted aluminum signs, punched or drilled for fasteners, with colors, legend, and size required for application.
2. 1/4-inch grommets in corners for mounting.
3. Nominal Size: 7 by 10 inches.

B. Metal-Backed Butyrate Signs:

1. Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs, with 0.0396-inch galvanized-steel backing, punched and drilled for fasteners, and with colors, legend, and size required for application.
2. 1/4-inch grommets in corners for mounting.
3. Nominal Size: 10 by 14 inches.

C. Laminated Acrylic or Melamine Plastic Signs:
1. Engraved legend.
2. Thickness:

a. For signs up to 20-sq. in., minimum 1/16-inch thick.
b. For signs larger than 20 sq. in., 1/8-inch thick.
c. Engraved legend with black letters on white face.
d. Punched or drilled for mechanical fasteners with 1/4-inch grommets in corners for mounting.
e. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.

2.8 CABLE TIES

A. General-Purpose Cable Ties: Fungus inert, self-extinguishing, one piece, self-locking, and Type 6/6 nylon.

1. Minimum Width: 3/16-inch.
2. Tensile Strength at 73°F according to ASTM D 638: 12,000-psi.
3. Temperature Range: Minus 40 to plus 185°F.
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, and Type 6/6 nylon.

1. Minimum Width: 3/16-inch.
2. Tensile Strength at 73°F according to ASTM D 638: 12,000-psi.
3. Temperature Range: Minus 40 to plus 185°F.
4. Color: Black.

C. Plenum-Rated Cable Ties: Self-extinguishing, UV stabilized, one piece, and self-locking.

1. Minimum Width: 3/16-inch.
2. Tensile Strength at 73°F according to ASTM D 638: 7000-psi.
3. UL 94 Flame Rating: 94V-0.
4. Temperature Range: Minus 50 to plus 284°F.
5. Color: Black.

2.9 MISCELLANEOUS IDENTIFICATION PRODUCTS

A. Paint: Comply with requirements in painting Sections for paint materials and application requirements. Retain 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

3.1 PREPARATION

A. Self-Adhesive Identification Products: Before applying electrical identification products, clean substrates of substances that could impair bond, using materials and methods recommended by manufacturer of identification product.

3.2 INSTALLATION

A. Verify and coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and operation and maintenance manual. Use consistent designations throughout Project.

B. Install identifying devices before installing acoustical ceilings and similar concealment.

C. Verify identity of each item before installing identification products.

D. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and operation and maintenance manual.

E. Apply identification devices to surfaces that require finish after completing finish work.

F. Install signs with approved legend to facilitate proper identification, operation, and maintenance of electrical systems and connected items.

G. System Identification for Raceways and Cables under 600 V: Identification shall completely encircle cable or conduit. Place identification of two-color markings in contact, side by side.

1. Secure tight to surface of conductor, cable, or raceway.

H. System Identification for Raceways and Cables over 600 V: Identification shall completely encircle cable or conduit. Place adjacent identification of two-color markings in contact, side by side.

1. Secure tight to surface of conductor, cable, or raceway.

I. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, and signal connections.

J. Emergency Operating Instruction Signs: Install instruction signs with white legend on a red background with minimum 3/8-inch high letters for emergency instructions at equipment used for power transfer or load shedding.

K. Elevated Components: Increase sizes of labels, signs, and letters to those appropriate for viewing from the floor.

L. Accessible Fittings for Raceways: Identify the covers of each junction and pull box of the following systems with the wiring system legend and system voltage. System legends shall be as follows:

1. "EMERGENCY POWER."
2. "POWER."
3. "UPS."

M. Vinyl Wraparound Labels:

1. Secure tight to surface of raceway or cable at a location with high visibility and accessibility.
2. Attach labels that are not self-adhesive type with clear vinyl tape, with adhesive appropriate to the location and substrate.

N. Snap-around Labels: Secure tight to surface at a location with high visibility and accessibility.

O. Self-Adhesive Wraparound Labels: Secure tight to surface at a location with high visibility and accessibility.

P. Self-Adhesive Labels:

1. On each item, install unique designation label that is consistent with wiring diagrams, schedules, and operation and maintenance manual.
2. Unless otherwise indicated, provide a single line of text with 1/2-inch high letters on 1-1/2-inch high label; where two lines of text are required, use labels 2-inches high.

Q. Snap-around Color-Coding Bands: Secure tight to surface at a location with high visibility and accessibility.

R. Marker Tapes: Secure tight to surface at a location with high visibility and accessibility.

S. Self-Adhesive Vinyl Tape: Secure tight to surface at a location with high visibility and accessibility.

1. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6-inches where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding.

T. Tape and Stencil: Comply with requirements in painting Sections for surface preparation and paint application.

U. Floor Marking Tape: Apply stripes to finished surfaces following manufacturer's written instructions.

V. Underground Line Warning Tape:

1. During backfilling of trenches, install continuous underground-line warning tape directly above cable or raceway 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.
2. Limit use of underground-line warning tape to direct-buried cables.
3. Install underground-line warning tape for direct-buried cables and cables in raceways.

W. Metal Tags:

1. Place in a location with high visibility and accessibility.
2. Secure using UV-stabilized cable ties.

X. Nonmetallic Preprinted Tags:

1. Place in a location with high visibility and accessibility.
2. Secure using UV-stabilized cable ties.

Y. Baked-Enamel Signs:

1. Attach signs that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
2. Unless otherwise indicated, provide a single line of text with 1/2-inch high letters on minimum 1-1/2-inch high sign; where two lines of text are required, use signs minimum 2-inches high.

Z. Metal-Backed Butyrate Signs:

1. Attach signs that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
2. Unless otherwise indicated, provide a single line of text with 1/2-inch high letters on 1-1/2-inch high sign; where two lines of text are required, use labels 2-inches high.

AA. Laminated Acrylic or Melamine Plastic Signs:

1. Attach signs that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
2. Unless otherwise indicated, provide a single line of text with 1/2-inch high letters on 1-1/2-inch high sign; where two lines of text are required, use labels 2-inches high.

BB. Cable Ties: General purpose, for attaching tags, except as listed below:

1. Outdoors: UV-stabilized nylon.
2. In Spaces Handling Environmental Air: Plenum rated.

3.3 IDENTIFICATION SCHEDULE

A. Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment. Install access doors or panels to provide view of identifying devices.

B. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, pull points, and locations of high visibility. Identify by system and circuit designation.

C. Accessible Raceways and Metal-Clad Cables, 600 V or Less, for Service, Feeder, and Branch Circuits, More Than 30A and 120V to Ground: Identify with self-adhesive raceway labels.

1. Locate identification 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.

D. Accessible Fittings for Raceways and Cables within Buildings: Identify the covers of each junction and pull box of the following systems with self-adhesive labels containing the wiring system legend and system voltage. System legends shall be as follows:

1. "EMERGENCY POWER."
2. "POWER."
3. "UPS."

E. Power-Circuit Conductor Identification, 600 V or Less: For conductors in vaults, pull and junction boxes, manholes, and handholes, use vinyl wraparound labelsto identify the phase.

1. Locate identification 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.

F. Control-Circuit Conductor Identification: For conductors and cables in pull and junction boxes, manholes, and handholes, use self-adhesive labels with the conductor or cable designation, origin, and destination.

G. Control-Circuit Conductor Termination Identification: For identification at terminations, provide self-adhesive labels with the conductor designation.

H. Conductors to Be Extended in the Future: Attach marker tape to conductors and list source.

I. Auxiliary Electrical Systems Conductor Identification: [Marker tape] [Self-adhesive vinyl tape] that is uniform and consistent with system used by manufacturer for factory-installed connections.

1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.

J. Locations of Underground Lines: Underground-line warning tape for power, lighting, communication, and control wiring and optical-fiber cable.

K. Workspace Indication: Apply floor marking tape or tape and stencil to finished surfaces. Show working clearances in the direction of access to live parts. Workspace shall comply with NFPA 70 and 29 CFR 1926.403 unless otherwise indicated. Do not install at flush-mounted panelboards and similar equipment in finished spaces.

L. Instructional Signs: Self-adhesive labels, including the color code for grounded and ungrounded conductors.

M. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Self-adhesive labels.

1. Apply to exterior of door, cover, or other access.
2. For equipment with multiple power or control sources, apply to door or cover of equipment, including, but not limited to, the following:

    a. Power-transfer switches.
    b. Controls with external control power connections.

N. Arc Flash Warning Labeling: Self-adhesive labels.

O. Operating Instruction Signs: Baked-enamel warning signs.

P. Equipment Identification Labels:

1. Indoor Equipment: Laminated acrylic or melamine plastic sign.
2. Outdoor Equipment: Laminated acrylic or melamine sign.
3. Equipment to Be Labeled:

    a. Panelboards: Typewritten directory of circuits in the location provided by panelboard manufacturer. Panelboard identification shall be in the form of a 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 indicated on Drawings for the transformer, feeder, and panelboards or equipment supplied by the secondary.
    g. Substations.
    h. Emergency system boxes and enclosures.
    i. Motor-control centers.
    j. Enclosed switches.
    k. Enclosed circuit breakers.
    l. Enclosed controllers.
    m. Variable-speed controllers.
    n. Push-button stations.
    o. Power-transfer equipment.
    p. Contactors.
    q. Remote-controlled switches, dimmer modules, and control devices.
    r. Battery-inverter units.
    s. Battery racks.
    t. Power-generating units.
    u. Monitoring and control equipment.
    v. UPS equipment.

END OF SECTION 26 05 53

SECTION 26 05 72 - OVERCURRENT PROTECTIVE DEVICE SHORT-CIRCUIT STUDY

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 a computer-based, fault-current study to determine the minimum interrupting capacity of circuit protective devices.

1.3 DEFINITIONS

A. Existing to Remain: Existing items of construction that are not to be removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

B. One-Line Diagram: A diagram which shows, by means of single lines and graphic symbols, the course of an electric circuit or system of circuits and the component devices or parts used therein.

C. Protective Device: A device that senses when an abnormal current flow exists and then removes the affected portion from the system.

D. SCCR: Short-circuit current rating.

E. Service: The conductors and equipment for delivering electric energy from the serving utility to the wiring system of the premises served.

1.4 ACTION SUBMITTALS

A. Product Data: For computer software program to be used for studies.

B. Other Action Submittals: Submit the following after the approval of system protective devices submittals. Submittals shall be in digital form.

1. Short-circuit study input data, including completed computer program input data sheets.
2. Short-circuit study and equipment evaluation report; signed, dated, and sealed by a qualified professional engineer.

    a. Submit study report for action prior to receiving final approval of the distribution equipment submittals. If formal completion of studies will cause delay in equipment manufacturing, obtain approval from Architect for preliminary submittal of sufficient study data to ensure that the selection of devices and associated characteristics is satisfactory.

b. Revised single-line diagram, reflecting field investigation results and results of short-circuit study.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Short-Circuit Study Specialist and Field Adjusting Agency.

B. Product Certificates: For short-circuit study software, certifying compliance with IEEE 399.

1.6 QUALITY ASSURANCE

A. Studies shall use computer programs that are distributed nationally and are in wide use. Software algorithms shall comply with requirements of standards and guides specified in this Section. Manual calculations are unacceptable.

B. Short-Circuit Study Specialist Qualifications: Professional engineer in charge of performing the study and documenting recommendations, licensed in the state where Project is located. All elements of the study shall be performed under the direct supervision and control of this professional engineer.

C. Field Adjusting Agency Qualifications: An independent agency, with the experience and capability to adjust overcurrent devices and 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.

PART 2 - PRODUCTS

2.1 COMPUTER SOFTWARE

A. Software Developers:

1. CGI CYME.
2. ETAP, Operation Technology.
3. Power Analytics Corporation.
4. SKM Systems Analysis.

B. Comply with IEEE 399 and IEEE 551.

C. Analytical features of fault-current-study computer software program shall have the capability to calculate "mandatory," "very desirable," and "desirable" features as listed in IEEE 399.

D. Computer software program shall be capable of plotting and diagramming time-current-characteristic curves as part of its output.

2.2 SHORT-CIRCUIT STUDY REPORT CONTENTS

A. Executive summary.

B. Study descriptions, purpose, basis, and scope. Include case descriptions, definition of terms, and guide for interpretation of the computer printout.

C. One-line diagram, showing the following:

1. Protective device designations and ampere ratings.
2. Cable size and lengths.
3. Transformer kilovolt ampere (kVA) and voltage ratings.
4. Motor and generator designations and kVA ratings.
5. Switchgear, switchboard, motor-control center, and panelboard designations.

D. Comments and recommendations for system improvements, where needed.

E. Protective Device Evaluation:

1. Evaluate equipment and protective devices and compare to short-circuit ratings.
2. Tabulations of circuit breaker, fuse, and other protective device ratings versus calculated short-circuit duties.
3. For 600-V overcurrent protective devices, ensure that interrupting ratings are equal to or higher than calculated 1/2-cycle symmetrical fault current.
4. For devices and equipment rated for asymmetrical fault current, apply multiplication factors listed in the standards to 1/2-cycle symmetrical fault current.
5. Verify adequacy of phase conductors at maximum three-phase bolted fault currents; verify adequacy of equipment grounding conductors and grounding electrode conductors at maximum ground-fault currents. Ensure that short-circuit withstand ratings are equal to or higher than calculated 1/2-cycle symmetrical fault current.

F. Short-Circuit Study Input Data: As described in "Power System Data" Article in the Evaluations.

G. Short-Circuit Study Output:

1. Low-Voltage Fault Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:

   a. Voltage.
   b. Calculated fault-current magnitude and angle.
   c. Fault-point X/R ratio.
   d. Equivalent impedance.

2. Momentary Duty Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:

   a. Voltage.
   b. Calculated symmetrical fault-current magnitude and angle.
   c. Fault-point X/R ratio.
   d. Calculated asymmetrical fault currents:

      1) Based on fault-point X/R ratio.
      2) Based on calculated symmetrical value multiplied by 1.6.
      3) Based on calculated symmetrical value multiplied by 2.7.

3. Interrupting Duty Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:

   a. Voltage.

b. Calculated symmetrical fault-current magnitude and angle.
c. Fault-point X/R ratio.
d. No AC Decrement (NACD) ratio.
e. Equivalent impedance.
f. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on a symmetrical basis.
g. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on a total basis.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Obtain all data necessary for the conduct of the study.

1. Verify completeness of data supplied on the one-line diagram. Call any discrepancies to the attention of Architect.
2. For equipment provided that is Work of this Project, use characteristics submitted under the provisions of action submittals and information submittals for this Project.
3. For equipment that is existing to remain, obtain required electrical distribution system data by field investigation and surveys, conducted by qualified technicians and engineers. The qualifications of technicians and engineers shall be qualified as defined by NFPA 70E.

B. Gather and tabulate the following input data to support the short-circuit study. Comply with recommendations in IEEE 551 as to the amount of detail that is required to be acquired in the field. Field data gathering shall be under the direct supervision and control of the engineer in charge of performing the study, and shall be by the engineer or its representative who holds NETA ETT Level III certification or NICET Electrical Power Testing Level III certification.

1. Product Data for Project's overcurrent protective devices involved in overcurrent protective device coordination studies. Use equipment designation tags that are consistent with electrical distribution system diagrams, overcurrent protective device submittals, input and output data, and recommended device settings.
2. Obtain electrical power utility impedance at the service.
3. Power sources and ties.
4. For transformers, include kVA, primary and secondary voltages, connection type, impedance, X/R ratio, taps measured in percent, and phase shift.
5. For reactors, provide manufacturer and model designation, voltage rating, and impedance.
6. For circuit breakers and fuses, provide manufacturer and model designation. List type of breaker, type of trip, SCCR, current rating, and breaker settings.
7. Generator short-circuit current contribution data, including short-circuit reactance, rated kVA, rated voltage, and X/R ratio.
8. Busway manufacturer and model designation, current rating, impedance, lengths, and conductor material.
9. Motor horsepower and NEMA MG 1 code letter designation.
10. Cable sizes, lengths, number, conductor material and conduit material (magnetic or nonmagnetic).

3.2 SHORT-CIRCUIT STUDY

A. Perform study following the general study procedures contained in IEEE 399.

B. Calculate short-circuit currents according to IEEE 551.

C. Base study on the device characteristics supplied by device manufacturer.

D. The extent of the electrical power system to be studied is indicated on Drawings.

E. Begin short-circuit current analysis at the service, extending down to the system overcurrent protective devices as follows:

1. To normal system low-voltage load buses where fault current is 10 kA or less.
2. Exclude equipment rated 240-V ac or less when supplied by a single transformer rated less than 125 kVA.

F. Study electrical distribution system from normal and alternate power sources throughout electrical distribution system for Project. Study all cases of system-switching configurations and alternate operations that could result in maximum fault conditions.

G. The calculations shall include the ac fault-current decay from induction motors, synchronous motors, and asynchronous generators and shall apply to low- and medium-voltage, three-phase ac systems. The calculations shall also account for the fault-current dc decrement, to address the asymmetrical requirements of the interrupting equipment.

1. For grounded systems, provide a bolted line-to-ground fault-current study for areas as defined for the three-phase bolted fault short-circuit study.

H. Calculate short-circuit momentary and interrupting duties for a three-phase bolted fault at each of the following:

1. Electric utility's supply termination point.
2. Incoming switchgear.
3. Unit substation primary and secondary terminals.
4. Low-voltage switchgear.
5. Motor-control centers.
6. Control panels.
7. Standby generators and automatic transfer switches.
8. Distribution panelboards.
9. Branch circuit panelboards.
10. Disconnect switches.

3.3 ADJUSTING

A. Make minor modifications to equipment as required to accomplish compliance with short-circuit study.

3.4 DEMONSTRATION

A. Train Owner's operating and maintenance personnel in the use of study results.

END OF SECTION 26 05 72

SECTION 26 05 73 - OVERCURRENT PROTECTIVE DEVICE COORDINATION STUDY

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 computer-based, overcurrent protective device coordination studies to determine overcurrent protective devices and to determine overcurrent protective device settings for selective tripping.

1. Study results shall be used to determine coordination of series-rated devices.

1.3 DEFINITIONS

A. Existing to Remain: Existing items of construction that are not to be removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

B. One-Line Diagram: A diagram which shows, by means of single lines and graphic symbols, the course of an electric circuit or system of circuits and the component devices or parts used therein.

C. Protective Device: A device that senses when an abnormal current flow exists and then removes the affected portion from the system.

D. SCCR: Short-circuit current rating.

E. Service: The conductors and equipment for delivering electric energy from the serving utility to the wiring system of the premises served.

1.4 ACTION SUBMITTALS

A. Product Data: For computer software program to be used for studies.

B. Other Action Submittals: Submit the following after the approval of system protective devices submittals. Submittals may be in digital form.

1. Coordination-study input data, including completed computer program input data sheets.
2. Study and equipment evaluation reports.
3. Overcurrent protective device coordination study report; signed, dated, and sealed by a qualified professional engineer.

a. Submit study report for action prior to receiving final approval of the distribution equipment submittals. If formal completion of studies will cause delay in equipment manufacturing, obtain approval from Architect for preliminary submittal of sufficient

study data to ensure that the selection of devices and associated characteristics is satisfactory.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Coordination Study Specialist and Field Adjusting Agency.

B. Product Certificates: For overcurrent protective device coordination study software, certifying compliance with IEEE 399.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For the overcurrent protective devices to include in emergency, operation, and maintenance manuals.

1. In addition to items specified in Section017823 "Operation and Maintenance Data," include the following:

a. The following parts from the Protective Device Coordination Study Report:

1) One-line diagram.
2) Protective device coordination study.
3) Time-current coordination curves.

b. Power system data.

1.7 QUALITY ASSURANCE

A. Studies shall use computer programs that are distributed nationally and are in wide use. Software algorithms shall comply with requirements of standards and guides specified in this Section. Manual calculations are unacceptable.

B. Coordination Study Specialist Qualifications: Professional engineer in charge of performing the study and documenting recommendations, licensed in the state where Project is located. All elements of the study shall be performed under the direct supervision and control of this professional engineer.

C. Field Adjusting Agency Qualifications: An independent agency, with the experience and capability to adjust overcurrent devices and 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.

PART 2 - PRODUCTS

2.1 COMPUTER SOFTWARE

A. Software Developers:

1. CGI CYME.

2. ETAP, Operation Technology.
3. Power Analytics Corporation.
4. SKM Systems Analysis.

B. Comply with IEEE 242 and IEEE 399.

C. Analytical features of device coordination study computer software program shall have the capability to calculate "mandatory," "very desirable," and "desirable" features as listed in IEEE 399.

D. Computer software program shall be capable of plotting and diagramming time-current-characteristic curves as part of its output. Computer software program shall report device settings and ratings of all overcurrent protective devices and shall demonstrate selective coordination by computer-generated, time-current coordination plots.

1. Optional Features:

a. Arcing faults.
b. Simultaneous faults.
c. Explicit negative sequence.
d. Mutual coupling in zero sequence.

2.2 PROTECTIVE DEVICE COORDINATION STUDY REPORT CONTENTS

A. Executive summary.

B. Study descriptions, purpose, basis and scope. Include case descriptions, definition of terms and guide for interpretation of the computer printout.

C. One-line diagram, showing the following:

1. Protective device designations and ampere ratings.
2. Cable size and lengths.
3. Transformer kilovolt ampere (kVA) and voltage ratings.
4. Motor and generator designations and kVA ratings.
5. Panelboard designations.

D. Study Input Data: As described in "Power System Data" Article.

E. Short-Circuit Study Output: As specified in "Short-Circuit Study Output" Paragraph in "Short-Circuit Study Report Contents" Article in Section260572 "Overcurrent Protective Device Short-Circuit Study."

F. Protective Device Coordination Study:

1. Report recommended settings of protective devices, ready to be applied in the field. Use manufacturer's data sheets for recording the recommended setting of overcurrent protective devices when available.

a. Phase and Ground Relays:

1) Device tag.
2) Relay current transformer ratio and tap, time dial, and instantaneous pickup value.

3) Recommendations on improved relaying systems, if applicable.

b. Circuit Breakers:

1) Adjustable pickups and time delays (long time, short time, ground).
2) Adjustable time-current characteristic.
3) Adjustable instantaneous pickup.
4) Recommendations on improved trip systems, if applicable.

c. Fuses: Show current rating, voltage, and class.

G. Time-Current Coordination Curves: Determine settings of overcurrent protective devices to achieve selective coordination. Graphically illustrate that adequate time separation exists between devices installed in series, including power utility company's upstream devices. Prepare separate sets of curves for the switching schemes and for emergency periods where the power source is local generation. Show the following information:

1. Device tag and title, one-line diagram with legend identifying the portion of the system covered.
2. Terminate device characteristic curves at a point reflecting maximum symmetrical or asymmetrical fault current to which the device is exposed.
3. Identify the device associated with each curve by manufacturer type, function, and, if applicable, tap, time delay, and instantaneous settings recommended.
4. Plot the following listed characteristic curves, as applicable:

a. Power utility's overcurrent protective device.
b. Medium-voltage equipment overcurrent relays.
c. Medium- and low-voltage fuses including manufacturer's minimum melt, total clearing, tolerance, and damage bands.
d. Low-voltage equipment circuit-breaker trip devices, including manufacturer's tolerance bands.
e. Transformer full-load current, magnetizing inrush current, and ANSI through-fault protection curves.
f. Cables and conductors damage curves.
g. Ground-fault protective devices.
h. Motor-starting characteristics and motor damage points.
i. Generator short-circuit decrement curve and generator damage point.
j. The largest feeder circuit breaker in each motor-control center and panelboard.

5. Provide adequate time margins between device characteristics such that selective operation is achieved.
6. Comments and recommendations for system improvements.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine Project overcurrent protective device submittals for compliance with electrical distribution system coordination requirements and other conditions affecting performance. Devices to be coordinated are indicated on Drawings.

1. Proceed with coordination study only after relevant equipment submittals have been assembled. Overcurrent protective devices that have not been submitted and approved prior to coordination study may not be used in study.

3.2 PROTECTIVE DEVICE COORDINATION STUDY

A. Comply with IEEE 242 for calculating short-circuit currents and determining coordination time intervals.

B. Comply with IEEE 399 for general study procedures.

C. The study shall be based on the device characteristics supplied by device manufacturer.

D. The extent of the electrical power system to be studied is indicated on Drawings.

E. Begin analysis at the service, extending down to the system overcurrent protective devices as follows:

1. To normal system low-voltage load buses where fault current is 10 kA or less.
2. Exclude equipment rated 240-V ac or less when supplied by a single transformer rated less than 125 kVA.

F. Study electrical distribution system from normal and alternate power sources throughout electrical distribution system for Project. Study all cases of system-switching configurations and alternate operations that could result in maximum fault conditions.

G. Transformer Primary Overcurrent Protective Devices:

1. Device shall not operate in response to the following:

a. Inrush current when first energized.
b. Self-cooled, full-load current or forced-air-cooled, full-load current, whichever is specified for that transformer.
c. Permissible transformer overloads according to IEEE C57.96 if required by unusual loading or emergency conditions.

2. Device settings shall protect transformers according to IEEE C57.12.00, for fault currents.

H. Motor Protection:

1. Select protection for low-voltage motors according to IEEE 242 and NFPA 70.
2. Select protection for motors served at voltages more than 600 V according to IEEE 620.

I. Conductor Protection: Protect cables against damage from fault currents according to ICEA P-32-382, ICEA P-45-482, and protection recommendations in IEEE 242. Demonstrate that equipment withstands the maximum short-circuit current for a time equivalent to the tripping time of the primary relay protection or total clearing time of the fuse. To determine temperatures that damage insulation, use curves from cable manufacturers or from listed standards indicating conductor size and short-circuit current.

J. Generator Protection: Select protection according to manufacturer's written recommendations and to IEEE 242.

K. The calculations shall include the ac fault-current decay from induction motors, synchronous motors, and asynchronous generators and shall apply to low- and medium-voltage, three-phase ac systems. The calculations shall also account for the fault-current dc decrement, to address the asymmetrical requirements of the interrupting equipment.

1. For grounded systems, provide a bolted line-to-ground fault-current study for areas as defined for the three-phase bolted fault short-circuit study.

L. Calculate short-circuit momentary and interrupting duties for a three-phase bolted fault and single line-to-ground fault at each of the following:

1. Electric utility's supply termination point.
2. Standby generators and automatic transfer switches.
3. Distribution panelboards.
4. Branch circuit panelboards.

M. Protective Device Evaluation:

1. Evaluate equipment and protective devices and compare to short-circuit ratings.
2. Adequacy of panelboard bus bars to withstand short-circuit stresses.
3. Any application of series-rated devices shall be recertified, complying with requirements in NFPA 70.

3.3 LOAD-FLOW AND VOLTAGE-DROP STUDY

A. Perform a load-flow and voltage-drop study to determine the steady-state loading profile of the system. Analyze power system performance two times as follows:

1. Determine load-flow and voltage drop based on full-load currents obtained in "Power System Data" Article.
2. Determine load-flow and voltage drop based on 80 percent of the design capacity of the load buses.
3. Prepare the load-flow and voltage-drop analysis and report to show power system components that are overloaded, or might become overloaded; show bus voltages that are less than as prescribed by NFPA 70.

3.4 POWER SYSTEM DATA

A. Obtain all data necessary for the conduct of the overcurrent protective device study.

1. Verify completeness of data supplied in the one-line diagram on Drawings. Call discrepancies to the attention of Architect.
2. For new equipment, use characteristics submitted under the provisions of action submittals and information submittals for this Project.
3. For existing equipment, whether or not relocated obtain required electrical distribution system data by field investigation and surveys, conducted by qualified technicians and engineers. The qualifications of technicians and engineers shall be qualified as defined by NFPA 70E.

B. Gather and tabulate the following input data to support coordination study. The list below is a guide. Comply with recommendations in IEEE 551 for the amount of detail required to be acquired in the field. Field data gathering shall be under the direct supervision and control of the engineer in charge of performing the study, and shall be by the engineer or its representative who holds NETA ETT Level III certification or NICET Electrical Power Testing Level III certification.

1. Product Data for overcurrent protective devices specified in other Sections and involved in overcurrent protective device coordination studies. Use equipment designation tags

that are consistent with electrical distribution system diagrams, overcurrent protective device submittals, input and output data, and recommended device settings.

2. Electrical power utility impedance at the service.
3. Power sources and ties.
4. Short-circuit current at each system bus, three phase and line-to-ground.
5. Full-load current of all loads.
6. Voltage level at each bus.
7. For transformers, include kVA, primary and secondary voltages, connection type, impedance, X/R ratio, taps measured in percent, and phase shift.
8. For reactors, provide manufacturer and model designation, voltage rating, and impedance.
9. For circuit breakers and fuses, provide manufacturer and model designation. List type of breaker, type of trip and available range of settings, SCCR, current rating, and breaker settings.
10. Generator short-circuit current contribution data, including short-circuit reactance, rated kVA, rated voltage, and X/R ratio.
11. For relays, provide manufacturer and model designation, current transformer ratios, potential transformer ratios, and relay settings.
12. Maximum demands from service meters.
13. Motor horsepower and NEMA MG 1 code letter designation.
14. Low-voltage cable sizes, lengths, number, conductor material, and conduit material (magnetic or nonmagnetic).
15. Data sheets to supplement electrical distribution system diagram, cross-referenced with tag numbers on diagram, showing the following:

    a. Special load considerations, including starting inrush currents and frequent starting and stopping.
    b. Transformer characteristics, including primary protective device, magnetic inrush current, and overload capability.
    c. Motor full-load current, locked rotor current, service factor, starting time, type of start, and thermal-damage curve.
    d. Generator thermal-damage curve.
    e. Ratings, types, and settings of utility company's overcurrent protective devices.
    f. Special overcurrent protective device settings or types stipulated by utility company.
    g. Time-current-characteristic curves of devices indicated to be coordinated.
    h. Manufacturer, frame size, interrupting rating in amperes rms symmetrical, ampere or current sensor rating, long-time adjustment range, short-time adjustment range, and instantaneous adjustment range for circuit breakers.
    i. Manufacturer and type, ampere-tap adjustment range, time-delay adjustment range, instantaneous attachment adjustment range, and current transformer ratio for overcurrent relays.
    j. Panelboards and SCCR in amperes rms symmetrical.
    k. Identify series-rated interrupting devices for a condition where the available fault current is greater than the interrupting rating of the downstream equipment. Obtain device data details to allow verification that series application of these devices complies with NFPA 70 and UL 489 requirements.

3.5 FIELD ADJUSTING

A. Adjust relay and protective device settings according to the recommended settings provided by the coordination study. Field adjustments shall be completed by the engineering service division of the equipment manufacturer under the Startup and Acceptance Testing contract portion.

B. Make minor modifications to equipment as required to accomplish compliance with short-circuit and protective device coordination studies.

C. Testing and adjusting shall be by a full-time employee of the Field Adjusting Agency, who holds NETA ETT Level III certification or NICET Electrical Power Testing Level III certification.

1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters. Perform NETA tests and inspections for all adjustable overcurrent protective devices.

3.6 DEMONSTRATION

A. Engage the Coordination Study Specialist to train Owner's maintenance personnel in the following:

1. Acquaint personnel in the fundamentals of operating the power system in normal and emergency modes.
2. Hand-out and explain the objectives of the coordination study, study descriptions, purpose, basis, and scope. Include case descriptions, definition of terms, and guide for interpreting the time-current coordination curves.
3. Adjust, operate, and maintain overcurrent protective device settings.

END OF SECTION 26 05 73

SECTION 26 05 74 - OVERCURRENT PROTECTIVE DEVICE ARC-FLASH STUDY

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 a computer-based, arc-flash study to determine the arc-flash hazard distance and the incident energy to which personnel could be exposed during work on or near electrical equipment.

1.3 DEFINITIONS

A. Existing to Remain: Existing items of construction that are not to be removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

B. One-Line Diagram: A diagram which shows, by means of single lines and graphic symbols, the course of an electric circuit or system of circuits and the component devices or parts used therein.

C. Protective Device: A device that senses when an abnormal current flow exists and then removes the affected portion from the system.

D. SCCR: Short-circuit current rating.

E. Service: The conductors and equipment for delivering electric energy from the serving utility to the wiring system of the premises served.

1.4 ACTION SUBMITTALS

A. Product Data: For computer software program to be used for studies.

B. Other Action Submittals: Submit the following submittals after the approval of system protective devices submittals. Submittals shall be in digital form.

1. Arc-flash study input data, including completed computer program input data sheets.
2. Arc-flash study report; signed, dated, and sealed by a qualified professional engineer.

    a. Submit study report for action prior to receiving final approval of the distribution equipment submittals. If formal completion of studies will cause delay in equipment manufacturing, obtain approval from Architect for preliminary submittal of sufficient study data to ensure that the selection of devices and associated characteristics is satisfactory.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Arc-Flash Study Specialist and Field Adjusting Agency.

B. Product Certificates: For arc-flash hazard analysis software, certifying compliance with IEEE 1584 and NFPA 70E.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance procedures according to requirements in NFPA 70E shall be provided in the equipment manuals.

B. Operation and Maintenance Procedures: In addition to items specified in Section 01 78 23 "Operation and Maintenance Data," provide maintenance procedures for use by Owner's personnel that comply with requirements in NFPA 70E.

1.7 QUALITY ASSURANCE

A. Studies shall use computer programs that are distributed nationally and are in wide use. Software algorithms shall comply with requirements of standards and guides specified in this Section. Manual calculations are unacceptable.

B. Arc-Flash Study Specialist Qualifications: Professional engineer in charge of performing the study, analyzing the arc flash, and documenting recommendations, licensed in the state where Project is located. All elements of the study shall be performed under the direct supervision and control of this professional engineer.

C. Field Adjusting Agency Qualifications: An independent agency, with the experience and capability to adjust overcurrent devices and 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.

PART 2 - PRODUCTS

2.1 COMPUTER SOFTWARE

A. Software Developers:

1. CGI CYME.
2. ETAP, Operation Technology.
3. Power Analytics Corporation.
4. SKM Systems Analysis.

B. Comply with IEEE 1584 and NFPA 70E.

C. Analytical features of device coordination study computer software program shall have the capability to calculate "mandatory," "very desirable," and "desirable" features as listed in IEEE 399.

2.2 ARC-FLASH STUDY REPORT CONTENT

A. Executive summary.

B. Study descriptions, purpose, basis and scope.

C. One-line diagram, showing the following:

1. Protective device designations and ampere ratings.
2. Cable size and lengths.
3. Transformer kilovolt ampere (kVA) and voltage ratings.
4. Motor and generator designations and kVA ratings.
5. Switchgear, switchboard, motor-control center and panelboard designations.

D. Study Input Data: As described in "Power System Data" Article.

E. Short-Circuit Study Output: As specified in "Short Circuit Study Output" Paragraph in "Short-Circuit Study Report Contents" Article in Section 26 05 72 "Overcurrent Protective Device Short-Circuit Study."

F. Protective Device Coordination Study Report Contents: As specified in "Protective Device Coordination Study Report Contents" Article in Section 26 05 73 "Overcurrent Protective Device Coordination Study."

G. Arc-Flash Study Output:

1. Interrupting Duty Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:

a. Voltage.
b. Calculated symmetrical fault-current magnitude and angle.
c. Fault-point X/R ratio.
d. No AC Decrement (NACD) ratio.
e. Equivalent impedance.
f. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on a symmetrical basis.
g. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on a total basis.

H. Incident Energy and Flash Protection Boundary Calculations:

1. Arcing fault magnitude.
2. Protective device clearing time.
3. Duration of arc.
4. Arc-flash boundary.
5. Working distance.
6. Incident energy.
7. Hazard risk category.
8. Recommendations for arc-flash energy reduction.

I. Fault study input data, case descriptions, and fault-current calculations including a definition of terms and guide for interpretation of the computer printout.

2.3 ARC-FLASH WARNING LABELS

A. Comply with requirements in Section 26 05 53 "Identification for Electrical Systems." Produce a 3.5-by-5-inch thermal transfer label of high-adhesion polyester for each work location included in the analysis.

B. The label shall have an orange header with the wording, "WARNING, ARC-FLASH HAZARD," and shall include the following information taken directly from the arc-flash hazard analysis:

1. Location designation.
2. Nominal voltage.
3. Flash protection boundary.
4. Hazard risk category.
5. Incident energy.
6. Working distance.
7. Engineering report number, revision number, and issue date.

C. Labels shall be machine printed, with no field-applied markings.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine Project overcurrent protective device submittals. Proceed with arc-flash study only after relevant equipment submittals have been assembled. Overcurrent protective devices that have not been submitted and approved prior to arc-flash study may not be used in study.

3.2 ARC-FLASH HAZARD ANALYSIS

A. Comply with NFPA 70E and its Annex D for hazard analysis study.

B. Preparatory Studies:

1. Short-Circuit Study Output: As specified in "Short-Circuit Study Output" Paragraph in "Short-Circuit Study Report Contents" Article in Section 26 05 72 "Overcurrent Protective Device Short-Circuit Study."

2. Protective Device Coordination Study Report Contents: As specified in "Protective Device Coordination Study Report Contents" Article in Section 26 05 73 "Overcurrent Protective Device Coordination Study."

C. Calculate maximum and minimum contributions of fault-current size.

1. The minimum calculation shall assume that the utility contribution is at a minimum and shall assume no motor load.
2. The maximum calculation shall assume a maximum contribution from the utility and shall assume motors to be operating under full-load conditions.

D. Calculate the arc-flash protection boundary and incident energy at locations in the electrical distribution system where personnel could perform work on energized parts.

E. Include medium- and low-voltage equipment locations, except equipment rated 240-V ac or less fed from transformers less than 125 kVA.

F. Safe working distances shall be specified for calculated fault locations based on the calculated arc-flash boundary, considering incident energy of 1.2 cal/sq.cm.

G. Incident energy calculations shall consider the accumulation of energy over time when performing arc-flash calculations on buses with multiple sources. Iterative calculations shall take into account the changing current contributions, as the sources are interrupted or decremented with time. Fault contribution from motors and generators shall be decremented as follows:

1. Fault contribution from induction motors should not be considered beyond three to five cycles.
2. Fault contribution from synchronous motors and generators should be decayed to match the actual decrement of each as closely as possible (e.g., contributions from permanent magnet generators will typically decay from 10 per unit to three per unit after 10 cycles).

H. Arc-flash computation shall include both line and load side of a circuit breaker as follows:

1. When the circuit breaker is in a separate enclosure.
2. When the line terminals of the circuit breaker are separate from the work location.

I. Base arc-flash calculations on actual overcurrent protective device clearing time. Cap maximum clearing time at two seconds based on IEEE 1584, Section B.1.2.

3.3 POWER SYSTEM DATA

A. Obtain all data necessary for the conduct of the arc-flash hazard analysis.

1. Verify completeness of data supplied on the one-line diagram on Drawings. Call discrepancies to the attention of Architect.
2. For new equipment, use characteristics submitted under the provisions of action submittals and information submittals for this Project.
3. For existing equipment, whether or not relocated, obtain required electrical distribution system data by field investigation and surveys, conducted by qualified technicians and engineers.

B. Electrical Survey Data: Gather and tabulate the following input data to support study. Comply with recommendations in IEEE 1584 and NFPA 70E as to the amount of detail that is required to be acquired in the field. Field data gathering shall be under the direct supervision and control of the engineer in charge of performing the study, and shall be by the engineer or its representative who holds NETA ETT Level III certification or NICET Electrical Power Testing Level III certification.

1. Product Data for overcurrent protective devices specified in other Sections and involved in overcurrent protective device coordination studies. Use equipment designation tags that are consistent with electrical distribution system diagrams, overcurrent protective device submittals, input and output data, and recommended device settings.
2. Obtain electrical power utility impedance at the service.
3. Power sources and ties.
4. Short-circuit current at each system bus, three phase and line-to-ground.
5. Full-load current of all loads.
6. Voltage level at each bus.
7. For transformers, include kVA, primary and secondary voltages, connection type, impedance, X/R ratio, taps measured in per cent, and phase shift.
8. For reactors, provide manufacturer and model designation, voltage rating and impedance.

9. For circuit breakers and fuses, provide manufacturer and model designation. List type of breaker, type of trip and available range of settings, SCCR, current rating, and breaker settings.
10. Generator short-circuit current contribution data, including short-circuit reactance, rated kVA, rated voltage, and X/R ratio.
11. For relays, provide manufacturer and model designation, current transformer ratios, potential transformer ratios, and relay settings.
12. Busway manufacturer and model designation, current rating, impedance, lengths, and conductor material.
13. Motor horsepower and NEMA MG 1 code letter designation.
14. Low-voltage cable sizes, lengths, number, conductor material and conduit material (magnetic or nonmagnetic).
15. Medium-voltage cable sizes, lengths, conductor material, and cable construction and metallic shield performance parameters.

3.4 LABELING

A. Apply one arc-flash label for 600-V ac, 480-V ac, and applicable 208-V ac panelboards and disconnects and for each of the following locations:

1. Motor-control center.
2. Low-voltage switchboard.
3. Switchgear.
4. Medium-voltage switch.
5. Control panel.

3.5 APPLICATION OF WARNING LABELS

A. Install the arc-fault warning labels under the direct supervision and control of the Arc-Flash Study Specialist.

3.6 DEMONSTRATION

A. Engage the Arc-Flash Study Specialist to train Owner's maintenance personnel in the potential arc-flash hazards associated with working on energized equipment and the significance of the arc-flash warning labels.

END OF SECTION 26 05 74

SECTION 26 22 13 - LOW-VOLTAGE DISTRIBUTION TRANSFORMERS

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: Distribution, dry-type transformers with a nominal primary and secondary rating of 600 V and less, with capacities up to 1500 kVA.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type and size of transformer.
2. Include rated nameplate data, capacities, typical impedance values, weights, dimensions, minimum clearances, installed devices and features, and performance for each type and size of transformer.

B. Shop Drawings:

1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
2. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment.
3. Include diagrams for power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

A. Source quality-control reports.

B. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For transformers to include in emergency, operation, and maintenance manuals.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Inspection: On receipt, inspect for and note any shipping damage to packaging and transformer.

1. If manufacturer packaging is removed for inspection, and transformer will be stored after inspection, re-package transformer using original or new packaging materials that provide protection equivalent to manufacturer's packaging.

B. Storage: Store in a warm, dry, and temperature-stable location in original shipping packaging.

C. 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.

D. Handling: Follow manufacturer's instructions for lifting and transporting transformers.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

1. Eaton Electrical Inc.; Cutler-Hammer Products.
2. General Electric Company.
3. Siemens Energy & Automation, Inc.
4. Square D; Schneider Electric.

B. Source Limitations: Obtain each transformer type from single source from single manufacturer.

2.2 GENERAL TRANSFORMER REQUIREMENTS

A. Description: Factory assembled and tested, air-cooled units for 60 Hz service.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Transformers Rated 15 kVA and Larger:

1. Comply with 10 CFR 431 (DOE 2016) efficiency levels.
2. Marked as compliant with DOE 2016 efficiency levels by an NRTL.

D. Shipping Restraints: Paint or otherwise color-code bolts, wedges, blocks, and other restraints that are to be removed after installation and before energizing. Use fluorescent colors that are easily identifiable inside the transformer enclosure.

2.3 DISTRIBUTION TRANSFORMERS

A. Comply with NFPA 70, and list and label as complying with UL 1561.

B. Cores: Electrical grade, non-aging silicon steel with high permeability and low hysteresis losses.

1. One leg per phase.

2. Core volume shall allow efficient transformer operation at 10 percent above the nominal tap voltage.
3. Grounded to enclosure.

C. Coils: Continuous windings without splices except for taps.

1. Coil Material: Aluminum.
2. Internal Coil Connections: Brazed or pressure type.
3. Terminal Connections: Welded.

D. Encapsulation: Transformers smaller than 30 kVA shall have core and coils completely resin encapsulated.

E. Enclosure:Totally enclosed, nonventilated.

1. NEMA 250, Type 3R: Core and coil shall be encapsulated within resin compound to seal out moisture and air.
2. KVA Ratings: Based on convection cooling only and not relying on auxiliary fans.
3. Wiring Compartment: Sized for conduit entry and wiring installation.
4. Finish: Comply with NEMA 250.

a. Finish Color: Gray weather-resistant enamel.

F. Enclosure: Totally enclosed, nonventilated.

1. NEMA 250, Type 4X, Stainless Steel: Core and coil shall be encapsulated within resin compound to seal out moisture and air.
2. KVA Ratings: Based on convection cooling only and not relying on auxiliary fans.
3. Wiring Compartment: Sized for conduit entry and wiring installation.

G. Enclosure: Totally enclosed, nonventilated.

1. NEMA 250, Type 3R: Core and coil shall be encapsulated within resin compound, sealing out moisture and air.
2. Wiring Compartment: Sized for conduit entry and wiring installation.
3. Finish: Comply with NEMA 250.

a. Finish Color: Gray weather-resistant enamel.

H. Enclosure: Totally enclosed, nonventilated.

1. NEMA 250, Type 4X, Stainless Steel: Core and coil shall be encapsulated within resin compound, sealing out moisture and air.
2. Wiring Compartment: Sized for conduit entry and wiring installation.

I. Taps for Transformers 3 kVA and Smaller: None.

J. Taps for Transformers 7.5 to 24 kVA: One 5% tap above and one 5% tap below normal full capacity.

K. Taps for Transformers 25 kVA and Larger: Two 2.5% taps above and two 2.5% taps below normal full capacity.

L. Insulation Class, Smaller than 30 kVA: 180°C, UL-component-recognized insulation system with a maximum of 115°C rise above 40°C ambient temperature.

M. Insulation Class, 30 kVA and Larger: 220°C, UL-component-recognized insulation system with a maximum of [115°C] [80°C] rise above 40°C ambient temperature.

N. Grounding: Provide ground-bar kit or a ground bar installed on the inside of the transformer enclosure.

O. Low-Sound-Level Requirements: Maximum sound levels when factory tested according to IEEE C57.12.91, as follows:

1. 9.00 kVA and Less: 40 dBA.
2. 9.01 to 30.00 kVA: 45 dBA.
3. 30.01 to 50.00 kVA: 45 dBA for K-factors of 1, 4, and 9.

2.4 IDENTIFICATION

A. Nameplates: Engraved, laminated-acrylic or melamine plastic signs for each distribution transformer, mounted with corrosion-resistant screws. Nameplates and label products are specified in Section 26 05 53 "Identification for Electrical Systems."

2.5 SOURCE QUALITY CONTROL

A. Test and inspect transformers according to IEEE C57.12.01 and IEEE C57.12.91.

1. Resistance measurements of all windings at the rated voltage connections and at all tap connections.
2. Ratio tests at the rated voltage connections and at all tap connections.
3. Phase relation and polarity tests at the rated voltage connections.
4. No load losses, and excitation current and rated voltage at the rated voltage connections.
5. Impedance and load losses at rated current and rated frequency at the rated voltage connections.
6. Applied and induced tensile tests.
7. Regulation and efficiency at rated load and voltage.
8. Insulation Resistance Tests:

   a. High-voltage to ground.
   b. Low-voltage to ground.
   c. High-voltage to low-voltage.

9. Temperature tests.

B. Factory Sound-Level Tests: Conduct prototype sound-level tests on production-line products.

PART 3 - EXECUTION

3.1 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 Section 26 05 26 "Grounding and Bonding for Electrical Systems" have been met. Maximum ground resistance shall be 5 ohms at location of transformer.

E. Environment: Enclosures shall be rated for the environment in which they are located. Covers for NEMA 250, Type 4X enclosures shall not cause accessibility problems.

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

3.2 INSTALLATION

A. Install transformers level and plumb on a concrete base with vibration-dampening supports. Locate transformers away from corners and not parallel to adjacent wall surface.

B. Construct concrete bases according to Section 03 30 00 "Cast-in-Place Concrete" and anchor floor-mounted transformers according to manufacturer's written instructions and requirements in Section 26 05 29 "Hangers and Supports for Electrical Systems."

1. Coordinate size and location of concrete bases with actual transformer provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified with concrete.

C. Secure transformer to concrete base according to manufacturer's written instructions.

D. Secure covers to enclosure and tighten all bolts to manufacturer-recommended torques to reduce noise generation.

E. Remove shipping bolts, blocking, and wedges.

3.3 CONNECTIONS

A. Ground equipment according to Section 26 05 26 "Grounding and Bonding for Electrical Systems."

B. Connect wiring according to Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables."

C. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.

D. Provide flexible connections at all conduit and conductor terminations and supports to eliminate sound and vibration transmission to the building structure.

3.4 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Small (Up to 167-kVA Single-Phase or 500-kVA Three-Phase) Dry-Type Transformer Field Tests:

1. Visual and Mechanical Inspection.

a. Inspect physical and mechanical condition.
b. Inspect anchorage, alignment, and grounding.
c. Verify that resilient mounts are free and that any shipping brackets have been removed.
d. Verify the unit is clean.
e. Perform specific inspections and mechanical tests recommended by manufacturer.
f. Verify that as-left tap connections are as specified.
g. Verify the presence of surge arresters and that their ratings are as specified.

2. Electrical Tests:

a. Measure resistance at each winding, tap, and bolted connection.
b. Perform insulation-resistance tests winding-to-winding and each winding-to-ground. Apply voltage according to manufacturer's published data. In the absence of manufacturer's published data, comply with NETA ATS, Table 100.5. Calculate polarization index: the value of the index shall not be less than 1.0.
c. Perform turns-ratio tests at all tap positions. Test results shall not deviate by more than one-half percent from either the adjacent coils or the calculated ratio. If test fails, replace the transformer.
d. Verify correct secondary voltage, phase-to-phase and phase-to-neutral, after energization and prior to loading.

C. Remove and replace units that do not pass tests or inspections and retest as specified above.

D. Test Labeling: On completion of satisfactory testing of each unit, attach a dated and signed "Satisfactory Test" label to tested component.

3.5 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 5% and not being lower than nameplate voltage minus 3% at maximum load conditions. Submit recording and tap settings as test results.

B. Output Settings Report: Prepare a written report recording output voltages and tap settings.

3.6 CLEANING

A. Vacuum dirt and debris; do not use compressed air to assist in cleaning.

END OF SECTION 26 22 13

SECTION 26 24 13 - SWITCHBOARDS

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. Service switchboard rated 600 V and less.
2. Disconnecting and overcurrent protective devices.
3. Instrumentation.
4. Control power.
5. Accessory components and features.
6. Identification.
7. Mimic bus.

1.3 ACTION SUBMITTALS

A. Product Data: For each switchboard, overcurrent protective device, accessory and component.

1. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.

B. Shop Drawings: For each switchboard and related equipment.

1. Include dimensioned plans, elevations, sections, and details, including required clearances and service space around equipment. Show tabulations of installed devices, equipment features, and ratings.
2. Detail enclosure types for types other than NEMA 250, Type 1.
3. Detail bus configuration, current, and voltage ratings.
4. Detail short-circuit current rating of switchboards and overcurrent protective devices.
5. Include descriptive documentation of barriers specified for electrical insulation and isolation.
6. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
7. Include time-current coordination curves for each type and rating of overcurrent protective device included in switchboards.
8. Include diagram and details of proposed mimic bus.
9. Include schematic and wiring diagrams for power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer and testing agency.

B. Field Quality-Control Reports:

1. Test procedures used.
2. Test results that comply with requirements.
3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For switchboards and components to include in emergency, operation, and maintenance manuals.

1. In addition to items specified in Section 01 78 23 "Operation and Maintenance Data," include the following:

a. Routine maintenance requirements for switchboards and all installed components.
b. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
c. Time-current coordination curves for each type and rating of overcurrent protective device included in switchboards.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Control-Power Fuses: Equal to two of each size and type.
2. Indicating Lights: Equal to one of each size and type.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: An employer of workers qualified as defined in NEMA PB 2.1 and trained in electrical safety as required by NFPA 70E.

B. Testing Agency Qualifications: Member company of NETA or an NRTL.

1. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver switchboards in sections or lengths that can be moved past obstructions in delivery path.

B. Remove loose packing and flammable materials from inside switchboards and install temporary electric heating (250 W per section) to prevent condensation.

C. Handle and prepare switchboards for installation according to NEMA PB 2.1.

1.9 FIELD CONDITIONS

A. Installation Pathway: Remove and replace access fencing, doors, lift-out panels, and structures to provide pathway for moving switchboards into place.

B. Environmental Limitations:

1. Do not deliver or install switchboards until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above switchboards is complete, and HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
2. Rate equipment for continuous operation under the following conditions unless otherwise indicated:

a. Ambient Temperature: Not exceeding 104°F.
b. Altitude: Not exceeding 6600-feet.

C. Unusual Service Conditions: NEMA PB 2, as follows:

1. Ambient temperatures within limits specified.
2. Altitude not exceeding 6600-feet.

D. 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 Construction Manager no fewer than ten 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 Construction Manager's written permission.
4. Comply with NFPA 70E.

1.10 COORDINATION

A. Coordinate layout and installation of switchboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

B. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified with concrete.

1.11 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to repair or replace switchboard enclosures, buswork, overcurrent protective devices, accessories, and factory installed interconnection wiring that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Three years from date of Substantial Completion.

B. Manufacturer's Warranty: Manufacturer's agrees to repair or replace surge protection devices that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

1. Square D; Schneider Electric (Basis of Design - QED-2 Switchboard)
2. ABB Group.
3. Eaton Electrical Inc.; Cutler-Hammer Products.
4. Siemens Energy & Automation, Inc.

2.2 GENERAL REQUIREMENTS

A. The following switchboard information is typically depicted on the Drawings: bus configuration, bus ratings, interrupting ratings, component size and type, power line and feeder connections, application specific control wiring, elevation and footprint, etc. Where not shown on or able to be derived from the Drawings, the minimum requirements specified herein shall be provided.

B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for switchboards including clearances between switchboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

D. Comply with NEMA PB 2.

E. Comply with NFPA 70.

F. Comply with UL 891.

G. Front-Connected, Front-Accessible Switchboards:

1. Main Devices: Fixed, individually mounted.
2. Branch Device: Fixed, individually mounted.
3. Sections front and rear aligned.

H. Nominal System Voltage: 480Y/277 V.

I. Main-Bus Continuous: 800 A.

J. Short Circuit Current Rating: 42 kA.

K. Outdoor Enclosures: Type 3R.

1. Finish: Factory-applied finish in manufacturer's standard color; undersurfaces treated with corrosion-resistant undercoating. Paint finish shall be medium gray in color, ANSI #49.

2. Enclosure: Flat roof; rear hinged doors for each section, with provisions for padlocking.

L. Barriers: Between adjacent switchboard sections.

M. Insulation and isolation for main bus of main section and main and vertical buses of feeder sections.

N. Switchboard shall contain three disconnecting means with overcurrent protection, a neutral bus with disconnecting link, and a main bonding jumper.

O. Removable, Rear Compartment Covers: Secured by standard bolts, for access to rear interior of switchboard.

P. Hinged Front Panels: Allow access to circuit breaker, metering, accessory, and blank compartments.

Q. Buses and Connections: Three phase, four wire unless otherwise indicated.

1. Provide phase bus arrangement A, B, C from front to back, top to bottom, and left to right when viewed from the front of the switchboard.
2. Phase- and Neutral-Bus Material: Hard-drawn copper of 98 percent conductivity.
3. Load Terminals: Insulated, rigidly braced, runback bus extensions, of same material as through buses, equipped with mechanical connectors for outgoing circuit conductors.
4. Ground Bus: Minimum-size required by UL 891, hard-drawn copper of 98 percent conductivity, equipped with mechanical connectors for feeder and branch-circuit ground conductors.
5. Main-Phase Buses and Equipment-Ground Buses: Uniform capacity for entire length of switchboard's main sections. Distribution section for Fire Pump connection shall have capacity as indicated on the Drawings.
6. Neutral Buses: 100 percent of the ampacity of phase buses unless otherwise indicated, equipped with mechanical connectors for outgoing circuit neutral cables.
7. Isolation Barrier Access Provisions: Permit checking of bus-bolt tightness.

R. Bus-Bar Insulation: Factory-applied, flame-retardant, tape wrapping of individual bus bars or flame-retardant, spray-applied insulation. Minimum insulation temperature rating of 105°C.

2.3 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

A. Molded-Case Circuit Breaker (MCCB): Comply with UL 489, with interrupting capacity to meet available fault currents.

1. Electronic trip circuit breakers with rms sensing; field-replaceable rating plug or field-replicable electronic trip; and the following field-adjustable settings:

   a. Instantaneous trip.
   b. Long- and short-time pickup levels.
   c. Long and short time adjustments.

2. MCCB Features and Accessories:

   a. Standard frame sizes, trip ratings, and number of poles. Provide 4-pole MCCB for each of the two Main Circuit Breakers.
   b. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor material.
   c. Application Listing: Appropriate for application.

d. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage without intentional time delay.
e. Auxiliary Contacts: One SPDT switch with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts, "b" contacts operate in reverse of circuit-breaker contacts.
f. Key Interlock Kit: Externally mounted to prohibit circuit-breaker operation; key shall be removable only when circuit breaker is in off position.

2.4 CONTROL POWER

A. Control Circuits: 120-V ac, supplied through secondary disconnecting devices from control-power transformer.

B. Electrically Interlocked Main Circuit Breakers: Two control-power transformers in separate compartments, with interlocking relays, connected to the primary side of each control-power transformer at the line side of the associated main circuit breaker. 120-V secondaries connected through automatic transfer relays to ensure a fail-safe automatic transfer scheme.

C. Control-Power Fuses: Primary and secondary fuses for current-limiting and overload protection of transformer and fuses for protection of control circuits.

D. Control Wiring: Factory installed, with bundling, lacing, and protection included. Provide flexible conductors for No. 8 AWG and smaller, for conductors across hinges, and for conductors for interconnections between shipping units.

2.5 ACCESSORY COMPONENTS AND FEATURES

A. Accessory Set: Include tools and miscellaneous items required for overcurrent protective device test, inspection, maintenance, and operation.

2.6 IDENTIFICATION

A. Mimic Bus: Continuously integrated mimic bus factory applied to front of switchboard. Arrange in single-line diagram format, using symbols and letter designations consistent with final mimic-bus diagram.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Receive, inspect, handle, and store switchboards according to NEMA PB 2.1.

1. Lift or move switchboards with spreader bars and manufacturer-supplied lifting straps following manufacturer's instructions.
2. Use rollers, slings, or other manufacturer-approved methods if lifting straps are not furnished.
3. Protect from moisture, dust, dirt, and debris during storage and installation.
4. Install temporary heating during storage per manufacturer's instructions.

B. Examine switchboards before installation. Reject switchboards that are moisture damaged or physically damaged.

C. Examine elements and surfaces to receive switchboards for compliance with installation tolerances and other conditions affecting performance of the Work or that affect the performance of the equipment.

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

3.2 INSTALLATION

A. Install switchboards and accessories according to NEMA PB 2.1.

B. Equipment Mounting: Install switchboards on concrete base, 4-inch nominal thickness. Comply with requirements for concrete base specified in Section 03 30 00 "Cast-in-Place Concrete."

1. Install conduits entering underneath the switchboard, entering under the vertical section where the conductors will terminate. Install with couplings flush with the concrete base. Extend 2-inches above concrete base after switchboard is anchored in place.
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 concrete base.
3. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
4. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
5. Install anchor bolts to elevations required for proper attachment to switchboards.
6. Anchor switchboard to building structure at the top of the switchboard if required or recommended by the manufacturer.

C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, straps and brackets, and temporary blocking of moving parts from switchboard units and components.

D. Operating Instructions: Frame and mount the printed basic operating instructions for switchboards, including control and key interlocking sequences and emergency procedures. Fabricate frame of finished wood or metal and cover instructions with clear acrylic plastic. Mount on front of switchboards.

E. Install filler plates in unused spaces of panel-mounted sections.

F. Install overcurrent protective devices and set field-adjustable switches and circuit-breaker trip ranges.

G. Comply with NECA 1.

3.3 CONNECTIONS

A. Bond conduits entering underneath the switchboard to the equipment ground bus with a bonding conductor sized per NFPA 70.

B. Support and secure conductors within the switchboard according to NFPA 70.

C. Extend insulated equipment grounding cable to busway ground connection and support cable at intervals in vertical run.

3.4 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems."

B. Switchboard Nameplates: Label each switchboard compartment with a nameplate complying with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems."

C. Device Nameplates: Label each disconnecting and overcurrent protective device and each meter and control device mounted in compartment doors with a nameplate complying with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems."

3.5 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Tests and inspections:

1. Acceptance Testing:

a. Test insulation resistance for each switchboard bus, component, connecting supply, feeder, and control circuit. Open control and metering circuits within the switchboard, and remove neutral connection to surge protection and other electronic devices prior to insulation test. Reconnect after test.
b. Test continuity of each circuit.

2. Test ground-fault protection of equipment for service equipment per NFPA 70.
3. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
4. Correct malfunctioning units on-site where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
5. Perform the following infrared scan tests and inspections, and prepare reports:

a. After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each switchboard. Remove front panels so joints and connections are accessible to portable scanner.
b. Instruments and Equipment:

1) Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.

6. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.

C. Switchboard will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports, including a certified report that identifies switchboards included and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.6 ADJUSTING

A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.

B. Set field-adjustable circuit-breaker trip ranges as specified in Section 26 05 73 "Overcurrent Protective Device Coordination Study".

3.7 PROTECTION

A. Temporary Heating: Apply temporary heat, to maintain temperature according to manufacturer's written instructions, until switchboard is ready to be energized and placed into service.

3.8 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain switchboards, overcurrent protective devices, instrumentation, and accessories, and to use and reprogram microprocessor-based trip, monitoring, and communication units.

END OF SECTION 26 24 13

SECTION 26 24 16 - PANELBOARDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Distribution panelboards.
2. Branch circuit panelboards.
3. Panelboards with integral SPD devices.

1.3 DEFINITIONS

A. ATS: Acceptance testing specification.

B. GFCI: Ground-fault circuit interrupter.

C. GFEP: Ground-fault equipment protection.

D. MCCB: Molded-case circuit breaker.

E. SPD: Surge protective device.

F. VPR: Voltage protection rating.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of panelboard.

1. Include materials, switching and overcurrent protective devices, SPDs, accessories, and components indicated.
2. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.

B. Shop Drawings: For each panelboard and related equipment.

1. Include dimensioned plans, elevations, sections, and details.
2. Show tabulations of installed devices with nameplates, conductor termination sizes, equipment features, and ratings.
3. Detail enclosure types including mounting and anchorage, environmental protection, knockouts, corner treatments, covers and doors, gaskets, hinges, and locks.
4. Detail bus configuration, current, and voltage ratings.
5. Short-circuit current rating of panelboards and overcurrent protective devices.

6. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
7. Include wiring diagrams for power, signal, and control wiring.
8. Include time-current coordination curves for each type and rating of overcurrent protective device included in panelboards. Include an Internet link for electronic access to downloadable PDF of the coordination curves.

1.5 INFORMATIONAL SUBMITTALS

A. Panelboard Schedules: For installation in panelboards.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For panelboards and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 "Operation and Maintenance Data," include the following:

1. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
2. Time-current curves, including selectable ranges for each type of overcurrent protective device that allows adjustments.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Keys: Two spares for each type of panelboard cabinet lock.
2. Circuit Breakers Including GFCI and GFEP Types: Two spares for each panelboard.
3. Fuses for Fused Switches: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.
4. Fuses for Fused Power-Circuit Devices: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.

1.8 QUALITY ASSURANCE

A. Manufacturer Qualifications: ISO 9001 or 9002 certified.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Remove loose packing and flammable materials from inside panelboards; install temporary electric heating (250 W per panelboard) to prevent condensation.

B. Handle and prepare panelboards for installation according to NEMA PB 1.

1.10 FIELD CONDITIONS

A. Environmental Limitations:

1. Do not deliver or install panelboards until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above panelboards is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
2. Rate equipment for continuous operation under the following conditions unless otherwise indicated:

    a. Ambient Temperature: Not exceeding minus 22°F to plus 104°F.
    b. Altitude: Not exceeding 6600-feet.

B. Service Conditions: NEMA PB 1, usual service conditions, as follows:

1. Ambient temperatures within limits specified.
2. Altitude not exceeding 6600-feet.

C. 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 Construction Manager no fewer than ten days in advance of proposed interruption of electric service.
2. Do not proceed with interruption of electric service without Construction Manager's written permission.
3. Comply with NFPA 70E.

1.11 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to repair or replace panelboards that fail in materials or workmanship within specified warranty period.

1. Panelboard Warranty Period: 18 months from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

1. Eaton Electrical Inc.; Cutler-Hammer Products.
2. General Electric Company.
3. Siemens Energy & Automation, Inc.
4. Square D; Schneider Electric.

B. Source Limitations: Obtain each panelboard type from single source from single manufacturer.

2.2 PANELBOARDS COMMON REQUIREMENTS

A. Product Selection for Restricted Space: Drawings indicate maximum dimensions for panelboards including clearances between panelboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Comply with NEMA PB 1.

D. Comply with NFPA 70.

E. Enclosures: Flush and Surface mounted, dead-front cabinets.

1. Rated for environmental conditions at installed location.

a. Indoor Dry and Clean Locations: NEMA 250, Type 1.
b. Outdoor Locations: NEMA 250, Type 3R Type 4X, stainless steel.
c. Wash-Down Areas: NEMA 250, Type 4X, stainless steel.
d. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.
e. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, Type 5, Type 12.

2. Height: 84-inches maximum.
3. Front: Secured to box with concealed trim clamps. For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box. Trims shall cover all live parts and shall have no exposed hardware.
4. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover. Trims shall cover all live parts and shall have no exposed hardware.
5. Skirt for Surface-Mounted Panelboards: Same gage and finish as panelboard front with flanges for attachment to panelboard, wall, and ceiling or floor.
6. Gutter Extension and Barrier: Same gage and finish as panelboard enclosure; integral with enclosure body. Arrange to isolate individual panel sections.
7. Finishes:

a. Panels and Trim: Steel and galvanized steel, factory finished immediately after cleaning and pretreating with manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat.
b. Back Boxes: Same finish as panels and trim.
c. Fungus Resistant: Fungicidal treatment for overcurrent protective devices and other components.

F. Incoming Mains:

1. Location: Convertible between top and bottom.
2. Main Breaker: Main lug interiors up to 400 amperes shall be field convertible to main breaker.

G. Phase, Neutral, and Ground Buses:

1. Material: Tin-plated aluminum.

a. Plating shall run entire length of bus.
b. Bus shall be fully rated the entire length.

2. Interiors shall be factory assembled into a unit. Replacing switching and protective devices shall not disturb adjacent units or require removing the main bus connectors.
3. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment grounding conductors; bonded to box.

4. Full-Sized Neutral: Equipped with full-capacity bonding strap for service entrance applications. Mount electrically isolated from enclosure. Do not mount neutral bus in gutter.

H. Conductor Connectors: Suitable for use with conductor material and sizes.

1. Material: Tin-plated aluminum.
2. Terminations shall allow use of 75°C rated conductors without derating.
3. Size: Lugs suitable for indicated conductor sizes, with additional gutter space, if required, for larger conductors.
4. Main and Neutral Lugs: Compression type, with a lug on the neutral bar for each pole in the panelboard.
5. Ground Lugs and Bus-Configured Terminators: Compression type, with a lug on the bar for each pole in the panelboard.
6. Feed-Through Lugs: Compression type, suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.
7. Subfeed (Double) Lugs: Compression type suitable for use with conductor material. Locate at same end of bus as incoming lugs or main device.
8. Gutter-Tap Lugs: Compression type suitable for use with conductor material and with matching insulating covers. Locate at same end of bus as incoming lugs or main device.

I. NRTL Label: Panelboards shall be labeled by an NRTL acceptable to authority having jurisdiction for use as service equipment with one or more main service disconnecting and overcurrent protective devices. Panelboards shall have meter enclosures, wiring, connections, and other provisions for utility metering. Coordinate with utility company for exact requirements.

J. Future Devices and Ampacity: Panelboards shall have mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.

1. Percentage of Future Space Capacity: 15 percent.
2. Space Capacity for Spare Circuit Breakers: As shown on Drawings.
3. Percentage of Future Panelboard Ampacity: 20 percent.

K. Panelboard Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals. Assembly listed by an NRTL for 100 percent interrupting capacity.

1. Panelboards and overcurrent protective devices rated 240V or less shall have short-circuit ratings as shown on Drawings, but not less than 10,000A rms symmetrical.
2. Panelboards and overcurrent protective devices rated above 240V and less than 600V shall have short-circuit ratings as shown on Drawings, but not less than 14,000A rms symmetrical.

2.3 PERFORMANCE REQUIREMENTS

A. Surge Suppression for Service Entrance rated Panelboards: Factory installed as an integral part of indicated panelboards, complying with UL 1449 SPD Type 1 if a Lightning Protection System is installed, otherwise complying with UL 1449 SPD Type 2.

2.4 DISTRIBUTION PANELBOARDS

A. Distribution panelboards: NEMA PB 1.

B. Doors: Secured with vault-type latch with tumbler lock; keyed alike.

1. For doors more than 36-inches high, provide two latches, keyed alike.

C. Mains: Circuit breaker or lugs only, as indicated on the drawings.

D. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, or plug-in circuit breakers where individual positive-locking device requires mechanical release for removal.

2.5 BRANCH-CIRCUIT PANELBOARDS

A. Panelboards: NEMA PB 1.

B. Mains: Circuit breaker or lugs only, as indicated on the drawings.

C. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.

D. Doors: Concealed hinges; secured with flush latch with tumbler lock; keyed alike.

2.6 PANELBOARDS WITH INTERGRAL SPD DEVICES

A. Panelboards: NEMA PB 1; with factory-installed, integral SPD; labeled by an NRTL for compliance with UL 67 and UL 1449 after installing SPD.

B. Doors: Secured with vault-type latch with tumbler lock; keyed alike.

C. Main Overcurrent Protective Devices: Bolt-on thermal-magnetic circuit breakers.

D. Branch Overcurrent Protective Devices: Bolt-on thermal-magnetic circuit breakers.

E. SPD.

1. Peak Surge Current Rating: The minimum single-pulse surge current withstand rating per phase shall not be less than 100 kA. The peak surge current rating shall be the arithmetic sum of the ratings of the individual MOVs in a given mode.

2. Protection modes and UL 1449 VPR for grounded wye circuits with 480Y/277 V 208Y/120 V, three-phase, four-wire circuits shall not exceed the following:

   a. Line to Neutral: [1200 V for 480Y/277 V] [700 V for 208Y/120 V].
   b. Line to Ground: [1200 V for 480Y/277 V] [700 V for 208Y/120 V].
   c. Neutral to Ground: [1200 V for 480Y/277 V] [700 V for 208Y/120 V].
   d. Line to Line: [2000 V for 480Y/277 V] [1200 V for 208Y/120 V].

3. SCCR: Equal to the SCCR of the panelboard in which installed, or exceed 100 kA.

4. Inominal Rating: 20 kA.

2.7 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

A. MCCB: Comply with UL 489, with interrupting capacity to meet available fault currents.

1. Thermal-Magnetic Circuit Breakers:

a. Inverse time-current element for low-level overloads.
b. Instantaneous magnetic trip element for short circuits.
c. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.

2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
3. Electronic Trip Circuit Breakers:

a. RMS sensing.
b. Field-replaceable rating plug or electronic trip.
c. Digital display of settings, trip targets, and indicated metering displays.
d. Multi-button keypad to access programmable functions and monitored data.
e. Ten-event, trip-history log. Each trip event shall be recorded with type, phase, and magnitude of fault that caused the trip.
f. Integral test jack for connection to portable test set or laptop computer.
g. Field-Adjustable Settings:

1) Instantaneous trip.
2) Long- and short-time pickup levels.
3) Long and short time adjustments.
4) Ground-fault pickup level, time delay, and I squared T response.

4. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller; let-through ratings less than NEMA FU 1, RK-5.
5. GFCI Circuit Breakers: Single- and double-pole configurations with Class A ground-fault protection (6-mA trip).
6. GFEP Circuit Breakers: Class B ground-fault protection (30-mA trip).
7. Arc-Fault Circuit Interrupter Circuit Breakers: Comply with UL 1699; 120/240-V, single-pole configuration.
8. Subfeed Circuit Breakers: Vertically mounted.
9. MCCB Features and Accessories:

a. Standard frame sizes, trip ratings, and number of poles.
b. Breaker handle indicates tripped status.
c. UL listed for reverse connection without restrictive line or load ratings.
d. Lugs: Compression style, suitable for number, size, trip ratings, and conductor materials.
e. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
f. Shunt Trip: [120-V] [24-V] trip coil energized from separate circuit, set to trip at 55 percent of rated voltage.
g. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage with field-adjustable 0.1- to 0.6-second time delay.
h. Rating Plugs: Three-pole breakers with ampere ratings greater than 100 amperes shall have interchangeable rating plugs or electronic adjustable trip units.
i. Multipole units enclosed in a single housing with a single handle.

2.8 IDENTIFICATION

A. Panelboard Label: Manufacturer's name and trademark, voltage, amperage, number of phases, and number of poles shall be located on the interior of the panelboard door.

B. Breaker Labels: Faceplate shall list current rating, UL and IEC certification standards, and AIC rating.

C. Circuit Directory: Computer-generated circuit directory mounted inside panelboard door with transparent plastic protective cover.

1. Circuit directory shall identify specific purpose with detail sufficient to distinguish it from all other circuits.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify actual conditions with field measurements prior to ordering panelboards to verify that equipment fits in allocated space in, and comply with, minimum required clearances specified in NFPA 70.

B. Receive, inspect, handle, and store panelboards according to NEMA PB 1.1.

C. Examine panelboards before installation. Reject panelboards that are damaged, rusted, or have been subjected to water saturation.

D. Examine elements and surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting performance of the Work.

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

3.2 INSTALLATION

A. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

B. Comply with NECA 1.

C. Install panelboards and accessories according to NECA 407.

D. Equipment Mounting:

1. Install panelboards on cast-in-place concrete equipment base(s). Comply with requirements for equipment bases and foundations specified in Section 03 30 00 "Cast-in-Place Concrete."
2. Attach panelboard to the vertical finished or structural surface behind the panelboard.

E. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from panelboards.

F. Mount top of trim 90 inches above finished floor unless otherwise indicated.

G. Mount panelboard cabinet plumb and rigid without distortion of box.

H. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.

I. Mount surface-mounted panelboards to steel slotted supports 5/8 inch in depth. Orient steel slotted supports vertically.

J. Install overcurrent protective devices and controllers not already factory installed.

1. Set field-adjustable, circuit-breaker trip ranges.
2. Tighten bolted connections and circuit breaker connections using calibrated torque wrench or torque screwdriver per manufacturer's written instructions.

K. Make grounding connections and bond neutral for services and separately derived systems to ground. Make connections to grounding electrodes, separate grounds for isolated ground bars, and connections to separate ground bars.

L. Install filler plates in unused spaces.

M. Stub four 1-inch empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future.

N. Arrange conductors in gutters into groups and bundle and wrap with wire ties.

3.3 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; install warning signs complying with requirements in Section 26 05 53 "Identification for Electrical Systems."

B. Create a directory to indicate installed circuit loads; incorporate Owner's final room designations. Obtain approval before installing. Handwritten directories are not acceptable. Install directory inside panelboard door.

C. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems."

D. Device Nameplates: Label each branch circuit device in distribution panelboards with a nameplate complying with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems."

E. Install warning signs complying with requirements in Section 26 05 53 "Identification for Electrical Systems" identifying source of remote circuit.

3.4 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Acceptance Testing Preparation:

1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
2. Test continuity of each circuit.

C. Tests and Inspections:

1. Perform each visual and mechanical inspection and electrical test for low-voltage air circuit breakers stated in NETA ATS, Paragraph 7.6 Circuit Breakers. Do not perform optional tests. Certify compliance with test parameters.
2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

D. Panelboards will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports, including a certified report that identifies panelboards included and that describes scanning results, with comparisons of the two scans. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.5 ADJUSTING

A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.

B. Set field-adjustable circuit-breaker trip ranges as specified in Section 26 05 73 "Overcurrent Protective Device Coordination Study."

3.6 PROTECTION

A. Temporary Heating: Prior to energizing panelboards, apply temporary heat to maintain temperature according to manufacturer's written instructions.

END OF SECTION 26 24 16

SECTION 26 27 26 - WIRING DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Straight-blade convenience receptacles.
2. Hospital-grade receptacles.
3. Tamper-resistant receptacles.
4. USB charger devices.
5. GFCI receptacles.
6. Twist-locking receptacles.
7. Pendant cord-connector devices.
8. Cord and plug sets.
9. Wall plates.
10. Floor service outlets.

1.3 DEFINITIONS

A. Abbreviations of Manufacturers' Names:

1. Cooper: Cooper Wiring Devices; Division of Cooper Industries, Inc.
2. Hubbell: Hubbell Incorporated: Wiring Devices-Kellems.
3. Leviton: Leviton Mfg. Company, Inc.
4. Pass & Seymour: Pass& Seymour/Legrand.

B. BAS: Building automation system.

C. EMI: Electromagnetic interference.

D. GFCI: Ground-fault circuit interrupter.

E. Pigtail: Short lead used to connect a device to a branch-circuit conductor.

F. RFI: Radio-frequency interference.

G. SPD: Surge protective device.

H. UTP: Unshielded twisted pair.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: List of legends and description of materials and process used for premarking wall plates.

1.5 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For wiring devices to include in all manufacturers' packing-label warnings and instruction manuals that include labeling conditions.

PART 2 - PRODUCTS

2.1 GENERAL WIRING-DEVICE REQUIREMENTS

A. Wiring Devices, Components, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Comply with NFPA 70.

C. Devices that are manufactured for use with modular plug-in connectors may be substituted under the following conditions:

1. Connectors shall comply with UL 2459 and shall be made with stranding building wire.
2. Devices shall comply with the requirements in this Section.

D. Devices for Owner-Furnished Equipment:

1. Receptacles: Match plug configurations.
2. Cord and Plug Sets: Match equipment requirements.

E. Source Limitations: Obtain each type of wiring device and associated wall plate from single source from single manufacturer.

2.2 STRAIGHT-BLADE RECEPTACLES

A. Duplex Convenience Receptacles: 125 V, 20 A; comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498, and FS W-C-596.

1. 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).

2.3 USB CHARGER DEVICES

A. Tamper-Resistant, USB Charger Receptacles: 125 V, 20 A; comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498, UL 1310, and FS W-C-596.

1. Description: Single-piece, rivetless, nickel-plated, all-brass grounding system. Nickel-plated, brass mounting strap.
2. USB Receptacles: [**Single**] [**Dual**] [**Quad**], Type A.
3. Line Voltage Receptacles: [**Single**] [**Dual**], two pole, three wire, and self-grounding.

2.4 GFCI RECEPTACLES

A. General Description:

1. 125 V, 20 A, straight blade, non-feed-through type.
2. Comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498, UL 943 Class A, and FS W-C-596.
3. Include indicator light that shows when the GFCI has malfunctioned and no longer provides proper GFCI protection.

B. Duplex GFCI Convenience Receptacles:

1. 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. Tamper-Resistant, Duplex GFCI Convenience Receptacles:

1.

2.5 TWIST-LOCKING RECEPTACLES

A. Twist-Lock, Single Convenience Receptacles: 125 V, 20 A; comply with NEMA WD 1, NEMA WD 6 Configuration L5-20R, and UL 498.

B. Twist-Lock, Isolated-Ground, Single Convenience Receptacles: 125 V, 20 A; comply with NEMA WD 1, NEMA WD 6 Configuration L5-20R, and UL 498.

1. Grounding: Equipment grounding contacts shall be connected only to the green grounding screw terminal of the device and with inherent electrical isolation from mounting strap. Isolation shall be integral to receptacle construction and not dependent on removable parts.

2.6 PENDANT CORD-CONNECTOR DEVICES

A. Description:

1. Matching, locking-type plug and receptacle body connector.
2. NEMA WD 6 Configurations L5-20P and L5-20R, heavy-duty grade, and FS W-C-596.
3. Body: Nylon, with screw-open, cable-gripping jaws and provision for attaching external cable grip.
4. 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.

2.7 CORD AND PLUG SETS

A. Description:

1. Match voltage and current ratings and number of conductors to requirements of equipment being connected.
2. Cord: Rubber-insulated, stranded-copper conductors, with Type SOW-A jacket; with green-insulated grounding conductor and ampacity of at least 130 percent of the equipment rating.
3. Plug: Nylon body and integral cable-clamping jaws. Match cord and receptacle type for connection.

2.8 TOGGLE SWITCHES

A. Comply with NEMA WD 1, UL 20, and FS W-S-896.

B. Switches, 120/277 V, 20 A:

1. Single Pole:

2.9 DECORATOR-STYLE DEVICES

A. Convenience Receptacles: Square face, 125 V, 15 A; comply with NEMA WD 1, NEMA WD 6 Configuration 5-15R, and UL 498.

B. Tamper-Resistant Convenience Receptacles: Square face, 125 V, 15 A; comply with NEMA WD 1, NEMA WD 6 Configuration 5-15R, and UL 498.

1. Description: Labeled to comply with NFPA 70, "Receptacles, Cord Connectors, and Attachment Plugs (Caps)" Article, "Tamper-Resistant Receptacles in Dwelling Units" Section.

C. Tamper-Resistant and Weather-Resistant Convenience Receptacles: Square face, 125 V, 15 A; comply with NEMA WD 1, NEMA WD 6 Configuration 5-15R, and UL 498.

1. Description: Labeled to comply with NFPA 70, "Receptacles, Cord Connectors, and Attachment Plugs (Caps)" Article, "Tamper-Resistant Receptacles in Dwelling Units" Section, when installed in wet and damp locations.

D. GFCI, **Feed**-Through Type, Convenience Receptacles: Square face, 125 V, 15 A; comply with NEMA WD 1, NEMA WD 6 Configuration 5-15R, UL 498, and UL 943 Class A.

E. GFCI, Tamper-Resistant and Weather-Resistant Convenience Receptacles: Square face, 125 V, 15 A; comply with NEMA WD 1, NEMA WD 6 Configuration 5-15R, UL 498, and UL 943 Class A.

1. Description: Labeled to comply with NFPA 70, "Receptacles, Cord Connectors, and Attachment Plugs (Caps)" Article, "Tamper-Resistant Receptacles in Dwelling Units" Section.

F. Toggle Switches: Square Face, 120/277 V, 15 A; comply with NEMA WD 1, UL 20, and FS W-S-896.

G. Lighted Toggle Switches: Square Face, 120 V, 15 A; comply with NEMA WD 1 and UL 20.

1. Description: With LED-lighted handle, illuminated when switch is off.

2.10 WALL SWITCH SENSOR LIGHT SWITCH, DUAL TECHNOLOGY

A. Description: Switchbox-mounted, combination lighting-control sensor and conventional switch lighting-control unit using dual technology.

1. Connections: Provisions for connection to BAS.
2. Connections: Hard wired.
3. Connections: Wireless.
4. Rated 960 W at 120-V ac for tungsten lighting, 10 A at 120-V ac or 10 A at 277-V ac for fluorescent or LED lighting, and 1/4 hp at 120-V ac.
5. Integral relay for connection to BAS.
6. Adjustable time delay of [**five**] [**10**] [**15**] [**20**] minutes.
7. Able to be locked to [**Automatic-On**] [**Manual-On**] mode.
8. Automatic Light-Level Sensor: Adjustable from 2 to 200 fc.
9. Comply with NEMA WD 1, UL 20, and FS W-S-896.

2.11 DIGITAL TIMER LIGHT SWITCH

A. Description: Switchbox-mounted, combination digital timer and conventional switch lighting-control unit, with backlit digital display, with selectable time interval in [**10**] [**20**]-minute increments.

1. Rated 960 W at 120-V ac for tungsten lighting, 10 A at 120-V ac or 10 A at 277-V ac for fluorescent or LED lighting, and 1/4 hp at 120-V ac.
2. Integral relay for connection to BAS.

2.12 WALL PLATES

A. Single and combination types shall match corresponding wiring devices.

1. Plate-Securing Screws: Metal with head color to match plate finish.
2. Material for Finished Spaces: **Steel with white baked enamel, suitable for field painting**] [**Smooth, high-impact thermoplastic**] [**0.035-inch- (1-mm-) thick, satin-finished, Type 302 stainless steel**] [**0.04-inch- (1-mm-) thick, brushed brass with factory polymer finish**] [**0.05-inch- (1.2-mm-) thick, anodized aluminum**] [**0.04-inch- (1-mm-) thick steel with chrome-plated finish**].
3. Material for Unfinished Spaces: [**Galvanized steel**] [**Smooth, high-impact thermoplastic**].
4. Material for Damp Locations: [**Thermoplastic**] [**Cast aluminum**] with spring-loaded lift cover, and listed and labeled for use in wet and damp locations.

B. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with Type 3R, weather-resistant**, die-cast aluminum** with lockable cover.

2.13 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**] [**Round**], [**die-cast aluminum**] [**solid brass**] with satin finish.

D. Power Receptacle: NEMA WD 6 Configuration 5-20R, gray finish, unless otherwise indicated.

E. Voice and Data Communication Outlet: **Blank cover with bushed cable opening**

2.14 POKE-THROUGH ASSEMBLIES

A. Description:

1. Factory-fabricated and -wired assembly of below-floor junction box with multichanneled, through-floor raceway/firestop unit and detachable matching floor service-outlet assembly.
2. Comply with UL 514 scrub water exclusion requirements.
3. Service-Outlet Assembly: **Pedestal type with services indicated**
4. Size: Selected to fit nominal **3-inch (75-mm)** cored holes in floor and matched to floor thickness.
5. Fire Rating: Unit is listed and labeled for fire rating of floor-ceiling assembly.
6. Closure Plug: Arranged to close unused **3-inch (75-mm)** cored openings and reestablish fire rating of floor.
7. Wiring Raceways and Compartments: For a minimum of four No. 12 AWG conductors and a minimum of [**two**] [**four**], four-pair cables that comply with requirements in Section 27 15 00 "Communications Horizontal Cabling."

2.15 PREFABRICATED MULTIOUTLET ASSEMBLIES

A. Description:

1. Two-piece surface metal raceway, with factory-wired multioutlet harness.
2. Components shall be products from single manufacturer designed for use as a complete, matching assembly of raceways and receptacles.

B. Raceway Material: **Metal, with manufacturer's standard finish**.

C. Multioutlet Harness:

1. Receptacles: 15-A, 125-V, NEMA WD 6 Configuration 5-15R receptacles complying with NEMA WD 1, UL 498, and FS W-C-596.
2. Receptacle Spacing: **6 inches (150 mm)**.
3. Wiring: No. 12 AWG solid, Type THHN copper, **single circuit**.

2.16 FINISHES

A. Device Color:

1. Wiring Devices Connected to Normal Power System: **selected by Architect** unless otherwise indicated or required by NFPA 70 or device listing.
2. Wiring Devices Connected to Emergency Power System: **Red**.
3. SPD Devices: Blue.

B. Wall Plate Color: For plastic covers, match device color.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with NECA 1, including mounting heights listed in that standard, unless otherwise indicated.

B. Coordination with Other Trades:

1. Protect installed devices and their boxes. Do not place wall finish materials over device boxes and do not cut holes for boxes with routers that are guided by riding against outside of boxes.
2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
4. Install wiring devices after all wall preparation, including painting, is complete.

C. Conductors:

1. Do not strip insulation from conductors until right before they are spliced or terminated on devices.
2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
3. The length of free conductors at outlets for devices shall meet provisions of NFPA 70, Article 300, without pigtails.
4. Existing Conductors:

   a. Cut back and pigtail, or replace all damaged conductors.
   b. Straighten conductors that remain and remove corrosion and foreign matter.
   c. Pigtailing existing conductors is permitted, provided the outlet box is large enough.

D. Device Installation:

1. Replace devices that have been in temporary use during construction and that were installed before building finishing operations were complete.
2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.

4. Connect devices to branch circuits using pigtails that are not less than 6 inches (152 mm) in length.
5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, two-thirds to three-fourths of the way around terminal screw.
6. Use a torque screwdriver when a torque is recommended or required by manufacturer.
7. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.
8. Tighten unused terminal screws on the device.
9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device-mounting screws in yokes, allowing metal-to-metal contact.

E. Receptacle Orientation:

1. Install ground pin of vertically mounted receptacles [**up**] [**down**], and on horizontally mounted receptacles to the [**right**] [**left**].

2. Install hospital-grade receptacles in patient-care areas with the ground pin or neutral blade at the top.

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.

3.2 GFCI RECEPTACLES

A. Install non-feed-through-type GFCI receptacles where protection of downstream receptacles is not required.

3.3 IDENTIFICATION

A. Comply with Section 26 05 53 "Identification for Electrical Systems."

B. Identify each receptacle with panelboard identification and circuit number. Use hot, stamped, or engraved machine printing with [**black**] [**white**] [**red**]-filled lettering on face of plate, and durable wire markers or tags inside outlet boxes.

3.4 FIELD QUALITY CONTROL

A. Test Instruments: Use instruments that comply with UL 1436.

B. Test Instrument for Convenience Receptacles: Digital wiring analyzer with digital readout or illuminated digital-display indicators of measurement.

C. Perform the following tests and inspections **with the assistance of a factory-authorized service representative**:

1. In healthcare facilities, prepare reports that comply with recommendations in NFPA 99.
2. Test Instruments: Use instruments that comply with UL 1436.
3. Test Instrument for Convenience Receptacles: Digital wiring analyzer with digital readout or illuminated digital-display indicators of measurement.

D. Tests for Convenience Receptacles:

1. Line Voltage: Acceptable range is 105 to 132 V.
2. Percent Voltage Drop under 15-A Load: A value of 6 percent or higher is unacceptable.
3. Ground Impedance: Values of up to 2 ohms are acceptable.
4. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.
5. Using the test plug, verify that the device and its outlet box are securely mounted.
6. Tests shall be diagnostic, indicating damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault current path, defective devices, or similar problems. Correct circuit conditions, remove malfunctioning units and replace with new ones, and retest as specified above.

E. Wiring device will be considered defective if it does not pass tests and inspections.

F. Prepare test and inspection reports.

END OF SECTION 26 27 26

SECTION 26 28 13 - FUSES

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. Cartridge fuses rated 600V ac and less for use in the following:

   a. Enclosed switches.
   b. Control circuits.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product. Include construction details, material descriptions, dimensions of individual components and profiles. Include the following for each fuse type indicated:

1. Ambient Temperature Adjustment Information: If ratings of fuses have been adjusted to accommodate ambient temperatures, provide list of fuses with adjusted ratings.

   a. For each fuse having adjusted ratings, include location of fuse, original fuse rating, local ambient temperature, and adjusted fuse rating.
   b. Provide manufacturer's technical data on which ambient temperature adjustment calculations are based.

2. Dimensions and manufacturer's technical data on features, performance, electrical characteristics, and ratings.
3. Current-limitation curves for fuses with current-limiting characteristics.
4. Time-current coordination curves (average melt) and current-limitation curves (instantaneous peak let-through current) in PDF format for each type and rating of fuse.
5. Coordination charts and tables and related data.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For fuses to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 01 "Operation and Maintenance Data," include the following:

1. Ambient temperature adjustment information.
2. Current-limitation curves for fuses with current-limiting characteristics.

3. Time-current coordination curves (average melt) and current-limitation curves (instantaneous peak let-through current) in PDF format for each type and rating of fuse used on the Project.
4. Coordination charts and tables and related data.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.

1.6 FIELD CONDITIONS

A. Where ambient temperature to which fuses are directly exposed is less than 40°F or more than 100°F, apply manufacturer's ambient temperature adjustment factors to fuse ratings.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

1. Cooper Bussmann, Inc.
2. Edison Fuse, Inc.
3. Littelfuse, Inc.
4. Mersen.

B. Source Limitations: Obtain fuses, for use within a specific product or circuit, from single source from single manufacturer.

2.2 CARTRIDGE FUSES

A. Characteristics: NEMA FU 1, current-limiting, nonrenewable cartridge fuses with voltage ratings consistent with circuit voltages.

1. Type RK-1: 250V or 600V, 0 to 600A rating, 300 kAIC, time delay.
2. Type RK-5: 250V or 600V, 0 to 600A rating, 300 kAIC, time delay.
3. Type L: 600V, 601 to 6000A rating, 300 kAIC, time delay.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Comply with NEMA FU 1 for cartridge fuses.

D. Comply with NFPA 70.

E. Coordinate fuse ratings with utilization equipment nameplate limitations of maximum fuse size and with system short-circuit current levels.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine fuses before installation. Reject fuses that are moisture damaged or physically damaged.

B. Examine holders to receive fuses for compliance with installation tolerances and other conditions affecting performance, such as rejection features.

C. Examine utilization equipment nameplates and installation instructions. Install fuses of sizes and with characteristics appropriate for each piece of equipment.

D. Evaluate ambient temperatures to determine if fuse rating adjustment factors must be applied to fuse ratings.

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

3.2 FUSE APPLICATIONS

A. Cartridge Fuses:

1. Motor Branch Circuits: Class RK5**,** time delay.
2. Power Electronics Circuits: Class J, high speed.
3. Other Branch Circuits: Class RK5, time delay.
4. Control Transformer Circuits: Class CC, time delay, and control transformer duty.
5. Provide open-fuse indicator fuses or fuse covers with open fuse indication.

3.3 INSTALLATION

A. Install fuses in fusible devices. Arrange fuses so rating information is readable without removing fuse.

3.4 IDENTIFICATION

A. Install labels complying with requirements for identification specified in Section 26 "Identification for Electrical Systems" and indicating fuse replacement information inside of door of each fused switch and adjacent to each fuse block, socket, and holder.

END OF SECTION 26 28 13

SECTION 26 28 16 - ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Fusible switches.

1.3 DEFINITIONS

A. NC: Normally closed.

B. NO: Normally open.

C. SPDT: Single pole, double throw.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include nameplate ratings, 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 a nationally recognized testing laboratory (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. Provide in PDF electronic format.

B. Shop Drawings: For enclosed switches and circuit breakers.

1. Include plans, elevations, sections, details, and attachments to other work.
2. Include wiring diagrams for power, signal, and control wiring.

1.5 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For enclosed switches and circuit breakers to include in emergency, operation, and maintenance manuals.

1. In addition to items specified in Section 01 "Operation and Maintenance Data," include the following:

a. Manufacturer's written instructions for testing and adjusting enclosed switches and circuit breakers.
b. 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. Provide in PDF electronic format.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. 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.

1.8 FIELD CONDITIONS

A. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:

1. Ambient Temperature: Not less than minus 22 deg F and not exceeding 104 deg F.
2. Altitude: Not exceeding 6600 feet.

1.9 WARRANTY

A. Manufacturer's Warranty: Manufacturer and Installer agree to repair or replace components that fail in materials or workmanship within specified warranty period.

1. Warranty Period: One year from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

A. Source Limitations: Obtain enclosed switches and circuit breakers, overcurrent protective devices, components, and accessories, within same product category, 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 an NRTL, and marked for intended location and application.

D. Comply with NFPA 70.

2.2 FUSIBLE SWITCHES

A. Type HD, Heavy Duty:

1. Single throw.
2. Three pole.
3. 240 600-V ac.
4. 1200-A and smaller.
5. UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate specified fuses.
6. Lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

B. 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. Auxiliary Contact Kit: One NO/NC (Form "C") auxiliary contact(s), arranged to activate before switch blades open. Contact rating - **24-V ac**
5. Lugs: **Mechanical** type, suitable for number, size, and conductor material.

2.3 ENCLOSURES

A. Enclosed Switches and Circuit Breakers: UL 489, NEMA KS 1, NEMA 250, and UL 50, to comply with environmental conditions at installed location.

B. Enclosure Finish: The enclosure shall be finished with **gray baked enamel paint, electrodeposited on cleaned, phosphatized steel (NEMA 250 Type 1)**, **gray baked enamel paint, electrodeposited on cleaned, phosphatized galvannealed steel (NEMA 250 Types 3R, 12) a brush finish on Type 304 stainless steel (NEMA 250 Type 4-4X stainless steel)**, **copper-free cast aluminum alloy (NEMA 250 Types 7, 9)**.

C. Conduit Entry: NEMA 250 Types 4, 4X, and 12 enclosures shall contain no knockouts. NEMA 250 Types 7 and 9 enclosures shall be provided with threaded conduit openings in both endwalls.

D. Operating Mechanism: The circuit-breaker operating handle shall be **externally operable with the operating mechanism being an integral part of the box, not the cover**] [**directly operable through the front cover of the enclosure (NEMA 250 Type 1)**] [**directly operable**

through the dead front trim of the enclosure (NEMA 250 Type 3R), **externally operable with the operating mechanism being an integral part of the cover (NEMA 250 Types 7, 9)**. The cover interlock mechanism shall have an externally operated override. The override shall not permanently disable the interlock mechanism, which shall return to the locked position once the override is released. The tool used to override the cover interlock mechanism shall not be required to enter the enclosure in order to override the interlock.

E. Enclosures designated as NEMA 250 Type 4, 4X stainless steel, 12, or 12K shall have a dual cover interlock mechanism to prevent unintentional opening of the enclosure cover when the circuit breaker is ON and to prevent turning the circuit breaker ON when the enclosure cover is open.

F. NEMA 250 Type 7/9 enclosures shall be furnished with a breather and drain kit to allow their use in outdoor and wet location applications.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance of the Work.

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

1. Commencement of work shall indicate Installer's acceptance of the areas and conditions as satisfactory.

3.2 ENCLOSURE ENVIRONMENTAL RATING APPLICATIONS

A. Enclosed Switches and Circuit Breakers: Provide enclosures at installed locations with the following environmental ratings.

1. Indoor, Dry and Clean Locations: NEMA 250, **Type 1**.
2. Outdoor Locations: NEMA 250, **Type 3R**,**Type 4X**.
3. **Wash-Down** Areas: NEMA 250, **Type 4X**, **stainless steel**.
4. Other Wet or Damp, Indoor Locations: NEMA 250, **Type 4**.
5. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, Type 12.

3.3 INSTALLATION

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.

B. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.

C. Temporary Lifting Provisions: Remove temporary lifting of eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

D. Install fuses in fusible devices.

E. Comply with NFPA 70 and NECA 1.

3.4 IDENTIFICATION

A. Comply with requirements in Section 26 "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.

3.5 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

B. Perform tests and inspections.

C. Tests and Inspections for Switches:

1. Visual and Mechanical Inspection:

a. Inspect physical and mechanical condition.
b. Inspect anchorage, alignment, grounding, and clearances.
c. Verify that the unit is clean.
d. Verify blade alignment, blade penetration, travel stops, and mechanical operation.
e. Verify that fuse sizes and types match the Specifications and Drawings.
f. Verify that each fuse has adequate mechanical support and contact integrity.
g. Inspect bolted electrical connections for high resistance using one of the two following methods:

1) Use a low-resistance ohmmeter.

a) Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from those of similar bolted connections by more than 50 percent of the lowest value.

2) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data or NETA ATS Table 100.12.

a) Bolt-torque levels shall be in accordance with manufacturer's published data. In the absence of manufacturer's published data, use NETA ATS Table 100.12.

h. Verify that operation and sequencing of interlocking systems is as described in the Specifications and shown on the Drawings.
i. Verify correct phase barrier installation.
j. Verify lubrication of moving current-carrying parts and moving and sliding surfaces.

2. Electrical Tests:

a. Perform resistance measurements through bolted connections with a low-resistance ohmmeter. Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.
b. Measure contact resistance across each switchblade fuseholder. Drop values shall not exceed the high level of the manufacturer's published data. If manufacturer's published data are not available, investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.
c. Perform insulation-resistance tests for one minute on each pole, phase-to-phase and phase-to-ground with switch closed, and across each open pole. Apply voltage in accordance with manufacturer's published data. In the absence of manufacturer's published data, use Table 100.1 from the NETA ATS. Investigate values of insulation resistance less than those published in Table 100.1 or as recommended in manufacturer's published data.
d. Measure fuse resistance. Investigate fuse-resistance values that deviate from each other by more than 15 percent.
e. Perform ground fault test according to NETA ATS 7.14 "Ground Fault Protection Systems, Low-Voltage."

D. Enclosed switches and circuit breakers will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports.

1. Test procedures used.
2. Include identification of each enclosed switch and circuit breaker tested and describe test results.
3. List deficiencies detected, remedial action taken, and observations after remedial action.

3.6 ADJUSTING

A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.

B. Set field-adjustable circuit-breaker trip ranges **as specified in Section 26 "Overcurrent Protective Device Coordination Study."**

END OF SECTION 26 28 16

SECTION 26 32 13 - ENGINE GENERATORS

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 packaged engine-generator sets for **emergency** power supply with the following features:

1. **Diesel** engine.
2. **Unit-mounted** cooling system.
3. **Unit-mounted and remote-mounted** control and monitoring.
4. Performance requirements for sensitive loads.
5. Outdoor enclosure.

B. Related Requirements:

1. Section 26 36 00 "Transfer Switches" for transfer switches including sensors and relays to initiate automatic-starting and -stopping signals for engine-generator sets.

1.3 DEFINITIONS

A. Operational Bandwidth: The total variation from the lowest to highest value of a parameter over the range of conditions indicated, expressed as a percentage of the nominal value of the parameter.

B. EPS: Emergency power supply.

C. EPSS: Emergency power supply system.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
2. Include thermal damage curve for generator.
3. Include time-current characteristic curves for generator protective device.
4. Include fuel consumption in **gallons per hour** at 0.8 power factor at 0.5, 0.75 and 1.0 times generator capacity.
5. Include generator efficiency at 0.8 power factor at 0.5, 0.75 and 1.0 times generator capacity.

6. Include air flow requirements for cooling and combustion air in cfm at 0.8 power factor, with air supply temperature of 95, 80, 70, and 50 deg F. Provide drawings showing requirements and limitations for location of air intake and exhausts.
7. Include generator characteristics, including, but not limited to kw rating, efficiency, reactances, and short-circuit current capability.

B. Shop Drawings:

1. Include plans and elevations for engine-generator set and other components specified. Indicate access requirements affected by height of subbase fuel tank.
2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Identify fluid drain ports and clearance requirements for proper fluid drain.
4. Design calculations for selecting vibration isolators and seismic restraints and for designing vibration isolation bases.
5. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include base weights.
6. Include diagrams for power, signal, and control wiring. Complete schematic, wiring, and interconnection diagrams showing terminal markings for EPS equipment and functional relationship between all electrical components.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For **Installer**, **manufacturer and testing agency**.

B. Seismic Qualification Certificates: For engine-generator set, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: With engine and generator mounted on rails identify center of gravity and total weight **including full fuel tank**, **supplied enclosure, subbase-mounted fuel tank,** and each piece of equipment not integral to the engine-generator set, 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.

C. Source quality-control reports, including, but not limited to the following:

1. Certified summary of prototype-unit test report.
2. Certified Test Reports: For components and accessories that are equivalent, but not identical, to those tested on prototype unit.
3. Certified Summary of Performance Tests: Certify compliance with specified requirement to meet performance criteria for sensitive loads.
4. Report of factory test on units to be shipped for this Project, showing evidence of compliance with specified requirements.
5. Report of sound generation.
6. Report of exhaust emissions showing compliance with applicable regulations.
7. Certified Torsional Vibration Compatibility: Comply with NFPA 110.

D. Field quality-control reports.

E. Warranty: For special warranty.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For packaged engine generators to include in emergency, operation, and maintenance manuals.

1. In addition to items specified in Section 01 78 23 "Operation and Maintenance Data," include the following:

a. List of tools and replacement items recommended to be stored at Project for ready access. Include part and drawing numbers, current unit prices, and source of supply.
b. Operating instructions laminated and mounted adjacent to generator location.
c. Training plan.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Fuses: One for every 10 of each type and rating but no fewer than one of each.
2. Indicator Lamps: Two for every six of each type used, but no fewer than two of each.
3. Filters: One set each of lubricating oil, fuel, and combustion-air filters.
4. Tools: Each tool listed by part number in operations and maintenance manual.

1.8 QUALITY ASSURANCE

A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved by manufacturer.

B. Testing Agency Qualifications: Member company of NETA or an NRTL.

1. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.

1.9 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to repair or replace components of packaged engine generators and associated auxiliary components that fail in materials or workmanship within specified warranty period.

1. Warranty Period: 2 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain packaged generator sets and auxiliary components through one source from a single manufacturer.

B. Cummins Power Generation (Basis of Design)

C. Caterpillar

D. Generac

E. Stewart and Stevenson/MTU Onsite

2.2 PERFORMANCE REQUIREMENTS

A. ASME Compliance: Comply with ASME B15.1.

B. NFPA Compliance:

1. Comply with NFPA 37.
2. Comply with NFPA 70.
3. Comply with NFPA 99.
4. Comply with NFPA 110 requirements for Level **1** emergency power supply system.

C. UL Compliance: Comply with UL 2200.

D. Engine Exhaust Emissions: Comply with EPA Tier 3 requirements and applicable state and local government requirements.

E. Noise Emission: Comply with **applicable state and local government requirements** for maximum noise level at **adjacent property boundaries** due to sound emitted by generator set including engine, engine exhaust, engine cooling-air intake and discharge, and other components of installation.

F. Environmental Conditions: Engine-generator system shall withstand the following environmental conditions without mechanical or electrical damage or degradation of performance capability:

1. Ambient Temperature: **5 to 40 deg C**.
2. Relative Humidity: Zero to 95 percent.
3. Altitude: Sea level to **1000 feet (300 m)**.

G. Unusual Service Conditions: Engine-generator equipment and installation are required to operate under the following conditions:

1. **High salt-dust content in the air due to sea-spray evaporation**.

2.3 ASSEMBLY DESCRIPTION

A. Factory-assembled and -tested, water-cooled engine, with brushless generator and accessories.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a testing agency acceptable to authorities having jurisdiction, and marked for intended location and application.

C. EPSS Class: Engine-generator set shall be classified as a [**Class 2**] [**Class 6**] [**Class 48**] [**Class 96**] in accordance with NFPA 110.

D. Induction Method: **Naturally aspirated**.

E. Governor: Adjustable isochronous, with speed sensing.

F. Emissions: Comply with EPA Tier **3** requirements.

G. Mounting Frame: Structural steel framework to maintain alignment of mounted components without depending on concrete foundation. Provide lifting attachments sized and spaced to prevent deflection of base during lifting and moving.

1. Rigging Diagram: Inscribed on metal plate permanently attached to mounting frame to indicate location and lifting capacity of each lifting attachment and generator-set center of gravity.

H. Capacities and Characteristics:

1. Power Output Ratings: Nominal ratings as indicated at 0.8 power factor excluding power required for the continued and repeated operation of the unit and auxiliaries**, with capacity as required to operate as a unit as evidenced by records of prototype testing**.
2. Output Connections: Three-phase, **four** wire.
3. Nameplates: For each major system component to identify manufacturer's name and address, and model and serial number of component.

I. Generator-Set Performance:

1. Steady-State Voltage Operational Bandwidth: 3 percent of rated output voltage from no load to full load.
2. Transient Voltage Performance: Not more than 20 percent variation for 50 percent step-load increase or decrease. Voltage shall recover and remain within the steady-state operating band within three seconds.
3. Steady-State Frequency Operational Bandwidth: 0.5 percent of rated frequency from no load to full load.
4. Steady-State Frequency Stability: When system is operating at any constant load within the rated load, there shall be no random speed variations outside the steady-state operational band and no hunting or surging of speed.
5. Transient Frequency Performance: Less than 5 percent variation for 50 percent step-load increase or decrease. Frequency shall recover and remain within the steady-state operating band within five seconds.
6. Output Waveform: At no load, harmonic content measured line to line or line to neutral shall not exceed 5 percent total and 3 percent for single harmonics. Telephone influence factor, determined according to NEMA MG 1, shall not exceed 50 percent.

7. Sustained Short-Circuit Current: For a three-phase, bolted short circuit at system output terminals, system shall supply a minimum of 250 percent of rated full-load current for not less than 10 seconds and then clear the fault automatically, without damage to generator system components.

8. Start Time: Comply with NFPA 110, Type 10, system requirements.

J. Generator-Set Performance for Sensitive Loads:

1. Oversizing generator compared with the rated power output of the engine is permissible to meet specified performance.

   a. Nameplate Data for Oversized Generator: Show ratings required by the Contract Documents rather than ratings that would normally be applied to generator size installed.

2. Steady-State Voltage Operational Bandwidth: 1 percent of rated output voltage from no load to full load.
3. Transient Voltage Performance: Not more than 10 percent variation for 50 percent step-load increase or decrease. Voltage shall recover and remain within the steady-state operating band within 0.5 second.
4. Steady-State Frequency Operational Bandwidth: Plus or minus 0.25 percent of rated frequency from no load to full load.
5. Steady-State Frequency Stability: When system is operating at any constant load within the rated load, there shall be no random speed variations outside the steady-state operational band and no hunting or surging of speed.
6. Transient Frequency Performance: Less than 2-Hz variation for 50 percent step-load increase or decrease. Frequency shall recover and remain within the steady-state operating band within three seconds.
7. Output Waveform: At no load, harmonic content measured line to neutral shall not exceed 2 percent total with no slot ripple. Telephone influence factor, determined according to NEMA MG 1, shall not exceed 50 percent.
8. Sustained Short-Circuit Current: For a three-phase, bolted short circuit at system output terminals, system shall supply a minimum of 300 percent of rated full-load current for not less than 10 seconds and then clear the fault automatically, without damage to winding insulation or other generator system components.
9. Excitation System: Performance shall be unaffected by voltage distortion caused by nonlinear load.

   a. Provide permanent magnet excitation for power source to voltage regulator.

10. Start Time: Comply with NFPA 110, Type 10, system requirements.

K. Parallel Engine Generators:

1. Automatic reactive output power control and load sharing between generator sets operated in parallel.
2. Automatic regulation, automatic connection to a common bus, and automatic synchronization, with manual controls and instruments to monitor and control paralleling functions.
3. Protective relays required for equipment and personnel safety.
4. Paralleling suppressors to protect excitation systems.
5. Reverse power protection.
6. Loss of field protection.

2.4 ENGINE

A. Fuel: **Fuel oil, Grade DF-2**.

B. Rated Engine Speed: 1800 rpm.

C. Maximum Piston Speed for Four-Cycle Engines: 2250 fpm (11.4 m/s).

D. Lubrication System: The following items are mounted on engine or skid:

1. Filter and Strainer: Rated to remove 90 percent of particles 5 micrometers and smaller while passing full flow.
2. Thermostatic Control Valve: Control flow in system to maintain optimum oil temperature. Unit shall be capable of full flow and is designed to be fail-safe.
3. Crankcase Drain: Arranged for complete gravity drainage to an easily removable container with no disassembly and without use of pumps, siphons, special tools, or appliances.

E. Jacket Coolant Heater: Electric-immersion type, factory installed in coolant jacket system. Comply with NFPA 110 requirements for Level 1 equipment for heater capacity.

F. Cooling System: Closed loop, liquid cooled, with radiator factory mounted on engine-generator-set mounting frame and integral engine-driven coolant pump.

1. Coolant: Solution of 50 percent ethylene-glycol-based antifreeze and 50 percent water, with anticorrosion additives as recommended by engine manufacturer.
2. Size of Radiator: Adequate to contain expansion of total system coolant from cold start to 110 percent load condition.
3. Expansion Tank: Constructed of welded steel plate and rated to withstand maximum closed-loop coolant system pressure for engine used. Equip with gage glass and petcock.
4. Temperature Control: Self-contained, thermostatic-control valve modulates coolant flow automatically to maintain optimum constant coolant temperature as recommended by engine manufacturer.
5. Coolant Hose: Flexible assembly with inside surface of nonporous rubber and outer covering of aging-, ultraviolet-, and abrasion-resistant fabric.

a. Rating: 50-psig (345-kPa) maximum working pressure with coolant at 180 deg F (82 deg C), and noncollapsible under vacuum.
b. End Fittings: Flanges or steel pipe nipples with clamps to suit piping and equipment connections.

G. Cooling System: Closed loop, liquid cooled, with remote radiator and **integral engine-driven** coolant pump. Comply with requirements in Section 23 21 13 "Hydronic Piping" for coolant piping.

1. Configuration: **Vertical** air discharge.
2. Radiator Core Tubes: **Aluminum**.
3. Size of Radiator: Adequate to contain expansion of total system coolant from cold start to 110 percent load condition.
4. Expansion Tank: Constructed of welded steel plate and rated to withstand maximum closed-loop coolant system pressure for engine used. Equip with gage glass and petcock.

5. Fan: Driven by **multiple belts from engine shaft**.
6. Coolant: Solution of 50 percent ethylene-glycol-based antifreeze and 50 percent water, with anticorrosion additives as recommended by engine manufacturer.
7. Temperature Control: Self-contained, thermostatic-control valve modulates coolant flow automatically to maintain optimum constant coolant temperature as recommended by engine manufacturer.

H. Muffler/Silencer: Critical type, sized as recommended by engine manufacturer and selected with exhaust piping system to not exceed engine manufacturer's engine backpressure requirements.

1. Minimum sound attenuation of 25 dB at 500 Hz.
2. Sound level measured at a distance of 25 feet (8 m) from exhaust discharge after installation is complete shall be **78** dBA or less.

I. Muffler/Silencer: Semicritical type, sized as recommended by engine manufacturer and selected with exhaust piping system to not exceed engine manufacturer's engine backpressure requirements.

1. Minimum sound attenuation of 18 dB at 500 Hz.
2. Sound level measured at a distance of 25 feet (8 m) from exhaust discharge after installation is complete shall be **85** dBA or less.

J. Muffler/Silencer: Commercial type, sized as recommended by engine manufacturer and selected with exhaust piping system to not exceed engine manufacturer's engine backpressure requirements.

1. Minimum sound attenuation of 12 dB at 500 Hz.
2. Sound level measured at a distance of 25 feet (8 m) from exhaust discharge after installation is complete shall be **90** dBA or less.

K. Air-Intake Filter: **Standard**-duty, engine-mounted air cleaner with replaceable dry-filter element and "blocked filter" indicator.

L. Starting System: **12**-V electric, with negative ground.

1. Components: Sized so they are not damaged during a full engine-cranking cycle with ambient temperature at maximum specified in "Performance Requirements" Article.
2. Cranking Motor: Heavy-duty unit that automatically engages and releases from engine flywheel without binding.
3. Cranking Cycle: **As required by NFPA 110 for system level specified**.
4. Battery: **Lead acid**, with capacity within ambient temperature range specified in "Performance Requirements" Article to provide specified cranking cycle at least **twice** without recharging.
5. Battery Cable: Size as recommended by engine manufacturer for cable length indicated. Include required interconnecting conductors and connection accessories.
6. Battery Compartment: Factory fabricated of metal with acid-resistant finish and thermal insulation. Thermostatically controlled heater shall be arranged to maintain battery above 10 deg C regardless of external ambient temperature within range specified in "Performance Requirements" Article. Include accessories required to support and fasten batteries in place. Provide ventilation to exhaust battery gases.
7. Battery Stand: Factory-fabricated, two-tier metal with acid-resistant finish designed to hold the quantity of battery cells required and to maintain the arrangement to minimize lengths of battery interconnections.

8. Battery-Charging Alternator: Factory mounted on engine with solid-state voltage regulation and 35 A minimum continuous rating.

9. Battery Charger: Current-limiting, automatic-equalizing and float-charging type designed for **lead-acid** batteries. Unit shall comply with UL 1236 and include the following features:

   a. Operation: Equalizing-charging rate of 10 A shall be initiated automatically after battery has lost charge until an adjustable equalizing voltage is achieved at battery terminals. Unit shall then be automatically switched to a lower float-charging mode and shall continue to operate in that mode until battery is discharged again.
   b. Automatic Temperature Compensation: Adjust float and equalize voltages for variations in ambient temperature from minus 40 deg F (minus 40 deg C) to 140 deg F (plus 60 deg C) to prevent overcharging at high temperatures and undercharging at low temperatures.
   c. Automatic Voltage Regulation: Maintain constant output voltage regardless of input voltage variations up to plus or minus 10 percent.
   d. Ammeter and Voltmeter: Flush mounted in door. Meters shall indicate charging rates.
   e. Safety Functions: Sense abnormally low battery voltage and close contacts providing low battery voltage indication on control and monitoring panel. Sense high battery voltage and loss of ac input or dc output of battery charger. Either condition shall close contacts that provide a battery-charger malfunction indication at system control and monitoring panel.
   f. Enclosure and Mounting: NEMA 250, Type 1, wall-mounted cabinet.

M. Subbase-Mounted, Double-Wall, Fuel-Oil Tank: Factory installed and piped, complying with UL 142 fuel-oil tank. Features include the following:

1. Tank level indicator.
2. Fuel-Tank Capacity: Minimum 133 percent of total fuel required for periodic maintenance operations between fuel refills, plus fuel for the hours of continuous operation for indicated EPSS class.
3. Leak detection in interstitial space.
4. Vandal-resistant fill cap.
5. Containment Provisions: Comply with requirements of authorities having jurisdiction.

2.5 CONTROL AND MONITORING

A. Automatic Starting System Sequence of Operation: When mode-selector switch on the control and monitoring panel is in the automatic position, remote-control contacts in one or more separate automatic transfer switches initiate starting and stopping of generator set. When mode-selector switch is switched to the on position, generator set starts. The off position of same switch initiates generator-set shutdown. When generator set is running, specified system or equipment failures or derangements automatically shut down generator set and initiate alarms.

B. Manual Starting System Sequence of Operation: Switching on-off switch on the generator control panel to the on position starts generator set. The off position of same switch initiates generator-set shutdown. When generator set is running, specified system or equipment failures or derangements automatically shut down generator set and initiate alarms.

C. Provide minimum run time control set for **15** minutes with override only by operation of a remote emergency-stop switch.

D. Comply with UL 508A.

E. Configuration: Operating and safety indications, protective devices, basic system controls, and engine gages shall be grouped in a common control and monitoring panel mounted on the generator set. Mounting method shall isolate the control panel from generator-set vibration. Panel shall be powered from the engine-generator set battery.

F. Configuration: Operating and safety indications, protective devices, basic system controls, and engine gages shall be grouped in a common wall-mounted control and monitoring panel. Panel shall be powered from the engine-generator set battery.

G. Configuration: Operating and safety indications, protective devices, basic system controls, engine gages, instrument transformers, generator disconnect switch or circuit breaker, and other indicated components shall be grouped in a combination control and power panel. Control and monitoring section of panel shall be isolated from power sections by steel barriers. Panel shall be powered from the engine-generator set battery. Panel features shall include the following:

1. Wall-Mounting Cabinet Construction: Rigid, self-supporting steel unit complying with NEMA ICS 6. Power bus shall be copper. Bus, bus supports, control wiring, and temperature rise shall comply with UL 891.
2. Switchboard Construction: Freestanding unit complying with Section 26 24 13 "Switchboards."
3. Switchgear Construction: Freestanding unit complying with Section 26 23 00 "Low-Voltage Switchgear."

H. Indicating Devices : As required by NFPA 110 for Level **1** system, including the following:

1. AC voltmeter.
2. AC ammeter.
3. AC frequency meter.
4. EPS supplying load indicator.
5. Ammeter and voltmeter phase-selector switches.
6. DC voltmeter (alternator battery charging).
7. Engine-coolant temperature gage.
8. Engine lubricating-oil pressure gage.
9. Running-time meter.
10. Current and Potential Transformers: Instrument accuracy class.

I. Protective Devices and Controls in Local Control Panel: Shutdown devices and common visual alarm indication as required by NFPA 110 for Level **1** system, including the following:

1. Start-stop switch.
2. Overcrank shutdown device.
3. Overspeed shutdown device.
4. Coolant high-temperature shutdown device.
5. Coolant low-level shutdown device.
6. Low lube oil pressure shutdown device.
7. Air shutdown damper shutdown device when used.
8. Overcrank alarm.
9. Overspeed alarm.
10. Coolant high-temperature alarm.
11. Coolant low-temperature alarm.
12. Coolant low-level alarm.
13. Low lube oil pressure alarm.

14. Air shutdown damper alarm when used.
15. Lamp test.
16. Contacts for local and remote common alarm.
17. Coolant high-temperature prealarm.
18. Generator-voltage adjusting rheostat.
19. Main fuel tank low-level alarm.
    a. Low fuel level alarm shall be initiated when the level falls below that required for operation for the duration required in "Fuel Tank Capacity" Paragraph in "Diesel Fuel-Oil System" Article.
20. Run-Off-Auto switch.
21. Control switch not in automatic position alarm.
22. Low-starting air pressure alarm.
23. Low-starting hydraulic pressure alarm.
24. Low cranking voltage alarm.
25. Battery-charger malfunction alarm.
26. Battery low-voltage alarm.
27. Battery high-voltage alarm.
28. Generator overcurrent protective device not closed alarm.

J. Supporting Items: Include sensors, transducers, terminals, relays, and other devices and include wiring required to support specified items. Locate sensors and other supporting items on engine or generator, unless otherwise indicated.

K. Connection to Datalink: A separate terminal block, factory wired to Form C dry contacts, for each alarm and status indication. Provide connections for datalink transmission of indications to remote data terminals via **ModBus**. Data system connections to terminals are covered in Section 26 09 13 "Electrical Power Monitoring and Control."

L. Common Remote Panel with Common Audible Alarm: Comply with NFPA 110 requirements for Level **1** systems. Include necessary contacts and terminals in control and monitoring panel. Remote panel shall be powered from the engine-generator set battery.

M. Remote Alarm Annunciator: Comply with NFPA 99. An LED labeled with proper alarm conditions shall identify each alarm event, and a common audible signal shall sound for each alarm condition. Silencing switch in face of panel shall silence signal without altering visual indication. Connect so that after an alarm is silenced, clearing of initiating condition will reactivate alarm until silencing switch is reset. Cabinet and faceplate are surface- or flush-mounting type to suit mounting conditions indicated.

1. Overcrank alarm.
2. Coolant low-temperature alarm.
3. High engine temperature prealarm.
4. High engine temperature alarm.
5. Low lube oil pressure alarm.
6. Overspeed alarm.
7. Low fuel main tank alarm.
8. Low coolant level alarm.
9. Low cranking voltage alarm.
10. Contacts for local and remote common alarm.
11. Audible-alarm silencing switch.
12. Air shutdown damper when used.

13. Run-Off-Auto switch.
14. Control switch not in automatic position alarm.
15. Fuel tank derangement alarm.
16. Fuel tank high-level shutdown of fuel supply alarm.
17. Lamp test.
18. Low cranking voltage alarm.
19. Generator overcurrent protective device not closed.

N. Supporting Items: Include sensors, transducers, terminals, relays, and other devices and include wiring required to support specified items. Locate sensors and other supporting items on engine or generator, unless otherwise indicated.

O. Remote Emergency-Stop Switch: Flush; wall mounted, unless otherwise indicated; and labeled. Push button shall be protected from accidental operation.

2.6 GENERATOR OVERCURRENT AND FAULT PROTECTION

A. Overcurrent protective devices for the entire EPSS shall be coordinated to optimize selective tripping when a short circuit occurs. Coordination of protective devices shall consider both utility and EPSS as the voltage source.

1. Overcurrent protective devices for the EPSS shall be accessible only to authorized personnel.

B. Generator Circuit Breaker: Molded-case, thermal-magnetic type; 100 percent rated; complying with UL 489.

1. Tripping Characteristic: Designed specifically for generator protection.
2. Trip Rating: Matched to generator output rating.
3. Shunt Trip: Connected to trip breaker when generator set is shut down by other protective devices.
4. Mounting: Adjacent to or integrated with control and monitoring panel.

C. Generator Circuit Breaker: Molded-case, electronic-trip type; 100 percent rated; complying with UL 489.

1. Tripping Characteristics: Adjustable long-time and short-time delay and instantaneous.
2. Trip Settings: Selected to coordinate with generator thermal damage curve.
3. Shunt Trip: Connected to trip breaker when generator set is shut down by other protective devices.
4. Mounting: Adjacent to or integrated with control and monitoring panel.

D. Generator Circuit Breaker: Insulated-case, electronic-trip type; 100 percent rated; complying with UL 489.

1. Tripping Characteristics: Adjustable long-time and short-time delay and instantaneous.
2. Trip Settings: Selected to coordinate with generator thermal damage curve.
3. Shunt Trip: Connected to trip breaker when generator set is shut down by other protective devices.
4. Mounting: Adjacent to or integrated with control and monitoring panel.

E. Generator Disconnect Switch: Molded-case type, 100 percent rated.

1. Trip Rating: Matched to generator output rating.
2. Shunt Trip: Connected to trip switch when signaled by generator protector or by other protective devices.

F. Generator Protector: Microprocessor-based unit shall continuously monitor current level in each phase of generator output, integrate generator heating effect over time, and predict when thermal damage of alternator will occur. When signaled by generator protector or other generator-set protective devices, a shunt-trip device in the generator disconnect switch shall open the switch to disconnect the generator from load circuits. Protector performs the following functions:

1. Initiates a generator overload alarm when generator has operated at an overload equivalent to 110 percent of full-rated load for 60 seconds. Indication for this alarm is integrated with other generator-set malfunction alarms. Contacts shall be available for load shed functions.
2. Under single or three-phase fault conditions, regulates generator to 300 percent of rated full-load current for up to 10 seconds.
3. As overcurrent heating effect on the generator approaches the thermal damage point of the unit, protector switches the excitation system off, opens the generator disconnect device, and shuts down the generator set.
4. Senses clearing of a fault by other overcurrent devices and controls recovery of rated voltage to avoid overshoot.

G. Ground-Fault Indication: Comply with NFPA 70, "Emergency System" signals for ground fault.

1. Indicate ground fault with other generator-set alarm indications.
2. Trip generator protective device on ground fault.

2.7 GENERATOR, EXCITER, AND VOLTAGE REGULATOR

A. Comply with NEMA MG 1.

B. Drive: Generator shaft shall be directly connected to engine shaft. Exciter shall be rotated integrally with generator rotor.

C. Electrical Insulation: Class H or Class F.

D. Stator-Winding Leads: Brought out to terminal box to permit future reconnection for other voltages if required. Provide [**six**] [**12**] lead alternator.

E. Range: Provide [**limited**] [**broad**] [**extended**] range of output voltage by adjusting the excitation level.

F. Construction shall prevent mechanical, electrical, and thermal damage due to vibration, overspeed up to 125 percent of rating, and heat during operation at 110 percent of rated capacity.

G. Enclosure: Dripproof.

H. Instrument Transformers: Mounted within generator enclosure.

I. Voltage Regulator: Solid-state type, separate from exciter, providing performance as specified and as required by NFPA 110.

1. Adjusting Rheostat on Control and Monitoring Panel: Provide plus or minus 5 percent adjustment of output-voltage operating band.
2. Maintain voltage within [**15**] [**20**] [**30**] percent on one step, full load.
3. Provide anti-hunt provision to stabilize voltage.
4. Maintain frequency within [**5**] [**10**] [**15**] percent and stabilize at rated frequency within [**2**] [**5**] seconds.

J. Strip Heater: Thermostatically controlled unit arranged to maintain stator windings above dew point.

K. Windings: Two-thirds pitch stator winding and fully linked amortisseur winding.

L. Subtransient Reactance: **12** percent, maximum.

2.8 OUTDOOR GENERATOR-SET ENCLOSURE

A. Description: Vandal-resistant, sound-attenuating, weatherproof steel housing, wind resistant up to 100 mph (160 km/h). Multiple panels shall be lockable and provide adequate access to components requiring maintenance. Panels shall be removable by one person without tools. Instruments and control shall be mounted within enclosure.

B. Description: Prefabricated or pre-engineered galvanized-steel-clad, integral structural-steel-framed, walk-in enclosure, erected on concrete foundation.

1. Structural Design and Anchorage: Comply with ASCE 7 for wind loads up to 100 mph (160 km/h).
2. Hinged Doors: With padlocking provisions.
3. Space Heater: Thermostatically controlled and sized to prevent condensation.
4. Lighting: Provide weather resistant **LED** lighting with **30 footcandles** average maintained.
5. Thermal Insulation: Manufacturer's standard materials and thickness selected in coordination with space heater to maintain winter interior temperature within operating limits required by engine-generator-set components.
6. Muffler Location: **Within** enclosure.

C. Engine Cooling Airflow through Enclosure: Maintain temperature rise of system components within required limits when unit operates at 110 percent of rated load for 2 hours with ambient temperature at top of range specified in system service conditions.

1. Louvers: Fixed-engine, cooling-air inlet and discharge. Storm-proof and drainable louvers prevent entry of rain and snow.
2. Automatic Dampers: At engine cooling-air inlet and discharge. Dampers shall be closed to reduce enclosure heat loss in cold weather when unit is not operating.
3. Ventilation: Provide temperature-controlled exhaust fan interlocked to prevent operation when engine is running.

D. Interior Lights with Switch: Factory-wired, vapor-proof fixtures within housing; arranged to illuminate controls and accessible interior. Arrange for external electrical connection.

1. AC lighting system and connection point for operation when remote source is available.

2. DC lighting system for operation when remote source and generator are both unavailable.

E. Convenience Outlets: Factory wired, GFCI. Arrange for external electrical connection.

2.9 MOTORS

A. Description: NEMA MG 1, Design B, medium induction random-wound, squirrel cage motor.

B. Efficiency: Energy efficient, as defined in NEMA MG 1.

C. Service Factor: 1.15.

D. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.

E. 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.

F. Temperature Rise: Match insulation rating.

G. Code Letter Designation:

1. Motors **15** HP and Larger: NEMA starting Code F or Code G.
2. Motors Smaller than **15** HP: Manufacturer's standard starting characteristic.

H. Enclosure Material: Cast iron for motor frame sizes 324T and larger; rolled steel for motor frame sizes smaller than 324T.

I. Controllers, Electrical Devices, and Wiring: Electrical devices and connections are specified in electrical Sections.

2.10 VIBRATION ISOLATION DEVICES

A. Elastomeric Isolator Pads: Oil- and water-resistant elastomer or natural rubber, arranged in single or multiple layers, molded with a nonslip pattern and galvanized-steel baseplates of sufficient stiffness for uniform loading over pad area, and factory cut to sizes that match requirements of supported equipment.

1. Material: **Standard neoprene** separated by steel shims.
2. Shore "A" Scale Durometer Rating: **30**.
3. Number of Layers: **One**.
4. Minimum Deflection: **1 inch (25 mm)**.

B. Restrained Spring Isolators: Freestanding, steel, open-spring isolators with seismic restraint.

1. Housing: Steel with resilient vertical-limit stops to prevent spring extension due to wind loads or if weight is removed; factory-drilled baseplate bonded to 1/4-inch- (6-mm-) thick, elastomeric isolator pad attached to baseplate underside; and adjustable equipment mounting and leveling bolt that acts as blocking during installation.
2. Outside Spring Diameter: Not less than 80 percent of compressed height of the spring at rated load.

3. Minimum Additional Travel: 50 percent of 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. Minimum Deflection: **1 inch (25 mm)**.

C. Comply with requirements in Section 23 21 16 Hydronic Piping Specialties" for vibration isolation and flexible connectors materials for steel piping.

D. Comply with requirements in Section 23 31 13 "Metal Ducts" for vibration isolation and flexible connector materials for exhaust shroud and ductwork.

E. Vibration isolation devices shall not be used to accommodate misalignments or to make bends.

2.11 FINISHES

A. Indoor and Outdoor Enclosures and Components: Manufacturer's standard finish over corrosion-resistant pretreatment and compatible primer.

2.12 SOURCE QUALITY CONTROL

A. Prototype Testing: Factory test engine-generator set using same engine model, constructed of identical or equivalent components and equipped with identical or equivalent accessories.

1. Tests: Comply with NFPA 110, Level 1 Energy Converters and with IEEE 115.

B. Project-Specific Equipment Tests: Before shipment, factory test engine-generator set and other system components and accessories manufactured specifically for this Project. Perform tests at rated load and power factor. Include the following tests:

1. Test components and accessories furnished with installed unit that are not identical to those on tested prototype to demonstrate compatibility and reliability.
2. Test generator, exciter, and voltage regulator as a unit.
3. Full load run.
4. Maximum power.
5. Voltage regulation.
6. Transient and steady-state governing.
7. Single-step load pickup.
8. Safety shutdown.
9. Provide 14 days' advance notice of tests and opportunity for observation of tests by Owner's representative.
10. Report factory test results within 10 days of completion of test.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas, equipment bases, and conditions, with Installer present, for compliance with requirements for installation and other conditions affecting packaged engine-generator performance.

B. Examine roughing-in for piping systems and electrical connections. Verify actual locations of connections before packaged engine-generator installation.

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

3.2 PREPARATION

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 **Owner** no fewer than **two** working days in advance of proposed interruption of electrical service.
2. Do not proceed with interruption of electrical service without **Owner's** written permission.

3.3 INSTALLATION

A. Comply with packaged engine-generator manufacturers' written installation and alignment instructions and with NFPA 110.

B. Equipment Mounting:

1. Install packaged engine generators on cast-in-place concrete equipment bases.
2. Coordinate size and location of concrete bases for packaged engine generators **and remote radiators mounted on grade**. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified with concrete.
3. Coordinate size and location of roof curbs, equipment supports, and roof penetrations for remote radiators.

C. Install packaged engine-generator to provide access, without removing connections or accessories, for periodic maintenance.

D. Install **packaged engine-generator** with **elastomeric isolator pads** having a minimum deflection of **1 inch (25 mm)** on 4-inch- (100-mm-) high concrete base. Secure **enclosure** to anchor bolts installed in concrete bases. Concrete base construction is specified in Section 26 05 48.16 "Seismic Controls for Electrical Systems."

E. Install Schedule 40, black steel piping with welded joints for cooling water piping between engine-generator set and **heat exchanger**. Piping materials and installation requirements are specified in Section 23 21 13 "Hydronic Piping."

1. Install isolating thimbles where exhaust piping penetrates combustible surfaces. Provide a minimum of 9 inches (225 mm) clearance from combustibles.

2. Insulate cooling system piping and components according to requirements in Section 23 07 19 "HVAC Piping Insulation."

F. Install Schedule 40, black steel piping with welded joints and connect to engine muffler. Install thimble at wall. Piping shall be same diameter as muffler outlet.

1. Install flexible connectors and steel piping materials according to requirements in Section 23 21 16 Hydronic Piping Specialties."
2. Insulate muffler/silencer and exhaust system components according to requirements in Section 23 07 19 "HVAC Piping Insulation."
3. Install isolating thimbles where exhaust piping penetrates combustible surfaces with a minimum of 9 inches (225 mm) clearance from combustibles.

G. Install condensate drain piping to muffler drain outlet full size of drain connection with a shutoff valve, stainless-steel flexible connector, and Schedule 40, black steel pipe with welded joints.

H. Electrical Wiring: Install electrical devices furnished by equipment manufacturers but not specified to be factory mounted.

3.4 CONNECTIONS

A. Piping installation requirements are specified in other Sections. Drawings indicate general arrangement of piping and specialties.

B. Connect fuel, cooling-system, and exhaust-system piping adjacent to packaged engine-generator to allow service and maintenance.

C. Connect cooling-system water piping to engine-generator set and **heat exchanger** with flexible connectors.

D. Connect engine exhaust pipe to engine with flexible connector.

E. Ground equipment according to Section 26 05 26 "Grounding and Bonding for Electrical Systems."

F. Connect wiring according to Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables." Provide a minimum of one 90 degree bend in flexible conduit routed to the generator set from a stationary element.

G. Balance single-phase loads to obtain a maximum of 10 percent unbalance between any two phases.

3.5 IDENTIFICATION

A. Identify system components according to Section 23 05 53 "Identification for HVAC Piping and Equipment" and Section 26 05 53 "Identification for Electrical Systems."

B. Install a sign indicating the generator neutral is bonded to the main service neutral at the main service location.

3.6 FIELD QUALITY CONTROL

A. Testing Agency: **Engage** a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

C. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections.

D. Tests and Inspections:

1. Perform tests recommended by manufacturer and each visual and mechanical inspection and electrical and mechanical test listed in the first two subparagraphs as specified in NETA Acceptance Testing Specification. Certify compliance with test parameters.

a. Visual and Mechanical Inspection

1) Compare equipment nameplate data with drawings and specifications.
2) Inspect physical and mechanical condition.
3) Inspect anchorage, alignment, and grounding.
4) Verify the unit is clean.

b. Electrical and Mechanical Tests

1) Perform insulation-resistance tests in accordance with IEEE 43.

a) Machines larger than 200 horsepower (150 kilowatts). Test duration shall be 10 minutes. Calculate polarization index.
b) Machines 200 horsepower (150 kilowatts) or less. Test duration shall be one minute. Calculate the dielectric-absorption ratio.

2) Test protective relay devices.
3) Verify phase rotation, phasing, and synchronized operation as required by the application.
4) Functionally test engine shutdown for low oil pressure, overtemperature, overspeed, and other protection features as applicable.
5) Conduct performance test in accordance with NFPA 110.
6) Verify correct functioning of the governor and regulator.

2. NFPA 110 Acceptance Tests: Perform tests required by NFPA 110 that are additional to those specified here including, but not limited to, single-step full-load pickup test.
3. Battery Tests: Equalize charging of battery cells according to manufacturer's written instructions. Record individual cell voltages.

a. Measure charging voltage and voltages between available battery terminals for full-charging and float-charging conditions. Check electrolyte level and specific gravity under both conditions.
b. Test for contact integrity of all connectors. Perform an integrity load test and a capacity load test for the battery.
c. Verify acceptance of charge for each element of the battery after discharge.
d. Verify that measurements are within manufacturer's specifications.

4. Battery-Charger Tests: Verify specified rates of charge for both equalizing and float-charging conditions.
5. System Integrity Tests: Methodically verify proper installation, connection, and integrity of each element of engine-generator system before and during system operation. Check for air, exhaust, and fluid leaks.
6. Exhaust-System Back-Pressure Test: Use a manometer with a scale exceeding 40-inch wg (120 kPa). Connect to exhaust line close to engine exhaust manifold. Verify that back pressure at full-rated load is within manufacturer's written allowable limits for the engine.
7. Exhaust Emissions Test: Comply with applicable government test criteria.
8. Voltage and Frequency Transient Stability Tests: Use recording oscilloscope to measure voltage and frequency transients for 50 and 100 percent step-load increases and decreases, and verify that performance is as specified.
9. Harmonic-Content Tests: Measure harmonic content of output voltage at 25 percent and 100 percent of rated linear load. Verify that harmonic content is within specified limits.
10. Noise Level Tests: Measure A-weighted level of noise emanating from generator-set installation, including engine exhaust and cooling-air intake and discharge, at **four** locations **25 feet (7.6 m) from edge of the generator enclosure**, and compare measured levels with required values.

E. Coordinate tests with tests for transfer switches and run them concurrently.

F. Test instruments shall have been calibrated within the last 12 months, traceable to NIST Calibration Services, and adequate for making positive observation of test results. Make calibration records available for examination on request.

G. Leak Test: After installation, charge exhaust, coolant, and fuel systems and test for leaks. Repair leaks and retest until no leaks exist.

H. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation for generator and associated equipment.

I. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

J. Remove and replace malfunctioning units and **retest** as specified above.

K. Retest: Correct deficiencies identified by tests and observations and retest until specified requirements are met.

L. Report results of tests and inspections in writing. Record adjustable relay settings and measured insulation resistances, time delays, and other values and observations. Attach a label or tag to each tested component indicating satisfactory completion of tests.

M. Infrared Scanning: After Substantial Completion, but not more than 60 days after final acceptance, perform an infrared scan of each power wiring termination and each bus connection while running with maximum load. Remove all access panels so terminations and connections are accessible to portable scanner.

1. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan 11 months after date of Substantial Completion.
2. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.

3. Record of Infrared Scanning: Prepare a certified report that identifies terminations and connections checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.7 MAINTENANCE SERVICE

A. Initial Maintenance Service: Beginning at Substantial Completion, provide [**12**] <**Insert number**> months' full maintenance by skilled employees of manufacturer's designated service organization. Include quarterly exercising to check for proper starting, load transfer, and running under load. Include routine preventive maintenance as recommended by manufacturer and adjusting as required for proper operation. Provide parts and supplies same as those used in the manufacture and installation of original equipment.

3.8 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain packaged engine generators.

END OF SECTION 26 32 13

SECTION 26 36 00 - TRANSFER SWITCHES

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 **automatic and nonautomatic** transfer switches rated 600 V and less, including the following:

1. Bypass/isolation switches.
2. Remote annunciator system.
3. Remote annunciator and control system.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for transfer switches.
2. Include rated capacities, operating characteristics, electrical characteristics, and accessories.

B. Shop Drawings:

1. Include plans, elevations, sections, details showing minimum clearances, conductor entry provisions, gutter space, and installed features and devices.
2. Include material lists for each switch specified.
3. Single-Line Diagram: Show connections between transfer switch, **bypass/isolation switch,** power sources, and load; and show interlocking provisions for each combined transfer switch and bypass/isolation switch.
4. Riser Diagram: Show interconnection wiring between transfer switches, bypass/isolation switches, annunciators, and control panels.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For **manufacturer-authorized service representative**.

B. Seismic Qualification Certificates: For transfer switches, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.

2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

C. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For each type of product to include in emergency, operation, and maintenance manuals.

1. In addition to items specified in Section 01 78 23 "Operation and Maintenance Data," include the following:

a. Features and operating sequences, both automatic and manual.
b. List of all factory settings of relays; provide relay-setting and calibration instructions, including software, where applicable.

1.6 QUALITY ASSURANCE

A. Testing Agency Qualifications:

1. Member company of NETA.

a. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.

1.7 FIELD 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:

1. Notify [**Architect**] [**Construction Manager**] [**Owner**] no fewer than **two** days in advance of proposed interruption of electrical service.
2. Do not proceed with interruption of electrical service without [**Architect's**] [**Construction Manager's**] [**Owner's**] written permission.

1.8 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to repair or replace components of transfer switch or transfer switch components that fail in materials or workmanship within specified warranty period.

1. Warranty Period: [**12 months**] [**18 months**] [**Two years**] **<Insert time>** from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Comply with NEMA ICS 1.

C. Comply with NFPA 99.

D. Comply with NFPA 110.

E. Comply with UL 1008 unless requirements of these Specifications are stricter.

F. Indicated Current Ratings: Apply as defined in UL 1008 for continuous loading and total system transfer, including tungsten filament lamp loads not exceeding 30 percent of switch ampere rating, unless otherwise indicated.

G. Tested Fault-Current Closing and Short-Circuit Ratings: Adequate for duty imposed by protective devices at installation locations in Project under the fault conditions indicated, based on testing according to UL 1008.

1. Where transfer switch includes internal fault-current protection, rating of switch and trip unit combination shall exceed indicated fault-current value at installation location.

2. Short-time withstand capability for **three** cycles.

H. Repetitive Accuracy of Solid-State Controls: All settings shall be plus or minus 2 percent or better over an operating temperature range of minus 20 to plus 70 deg C.

I. Resistance to Damage by Voltage Transients: Components shall meet or exceed voltage-surge withstand capability requirements when tested according to IEEE C62.62. Components shall meet or exceed voltage-impulse withstand test of NEMA ICS 1.

J. Electrical Operation: Accomplish by a nonfused, momentarily energized solenoid or electric-motor-operated mechanism. Switches for emergency or standby purposes shall be mechanically and electrically interlocked in both directions to prevent simultaneous connection to both power sources unless closed transition.

K. Service-Rated Transfer Switch:

1. Comply with UL 869A and UL 489.
2. Provide terminals for bonding the grounding electrode conductor to the grounded service conductor.
3. In systems with a neutral, the bonding connection shall be on the neutral bus.
4. Provide removable link for temporary separation of the service and load grounded conductors.

5. Surge Protective Device: Service rated.

6. Ground-Fault Protection: Comply with UL 1008 for **normal bus**.
7. Service Disconnecting Means: Externally operated, manual **mechanically** actuated.

L. Neutral Switching: Where four-pole switches are indicated, provide **neutral pole switched simultaneously with phase poles**.

M. Neutral Terminal: Solid and fully rated unless otherwise indicated.

N. Oversize Neutral: Ampacity and switch rating of neutral path through units indicated for oversize neutral shall be double the nominal rating of circuit in which switch is installed.

O. Heater: Equip switches exposed to outdoor temperatures and humidity, and other units indicated, with an internal heater. Provide thermostat within enclosure to control heater.

P. Battery Charger: For generator starting batteries.

1. Float type, rated **2** A.
2. Ammeter to display charging current.
3. Fused ac inputs and dc outputs.

Q. Annunciation, Control, and Programming Interface Components: Devices at transfer switches for communicating with remote programming devices, annunciators, or annunciator and control panels shall have communication capability matched with remote device.

R. Factory Wiring: Train and bundle factory wiring and label, consistent with Shop Drawings, by color-code or by numbered or lettered wire and cable [**with printed**] [**tape**] [**shrinkable sleeve**] markers at terminations. Color-coding and wire and cable markers are specified in Section 26 05 53 "Identification for Electrical Systems."

1. Designated Terminals: Pressure type, suitable for types and sizes of field wiring indicated.
2. Power-Terminal Arrangement and Field-Wiring Space: Suitable for top, side, or bottom entrance of feeder conductors as indicated.
3. Control Wiring: Equipped with lugs suitable for connection to terminal strips.
4. Accessible via [**rear**] [**front**] access.

S. Enclosures: General-purpose NEMA 250, [**Type 1**] [**Type 3R**] [**Type 4X**] [**Type 12**], complying with NEMA ICS 6 and UL 508, unless otherwise indicated.

2.2 CONTACTOR-TYPE AUTOMATIC TRANSFER SWITCHES

A. Comply with Level 1 equipment according to NFPA 110.

B. Switch Characteristics: Designed for continuous-duty repetitive transfer of full-rated current between active power sources.

1. Limitation: Switches using molded-case switches or circuit breakers or insulated-case circuit-breaker components are unacceptable.
2. Switch Action: Double throw; mechanically held in both directions.
3. Contacts: Silver composition or silver alloy for load-current switching. Contactor-style automatic transfer-switch units, rated 600 A and higher, shall have separate arcing contacts.
4. Conductor Connectors: Suitable for use with conductor material and sizes.
5. Material: **Tin-plated aluminum**.
6. Main and Neutral Lugs: **Compression** type.
7. Ground Lugs and Bus-Configured Terminators: **Compression** type.
8. Ground bar.
9. Connectors shall be marked for conductor size and type according to UL 1008.

C. Automatic Open-Transition Transfer Switches: Interlocked to prevent the load from being closed on both sources at the same time.

1. Sources shall be mechanically and electrically interlocked to prevent closing both sources on the load at the same time.

D. Automatic Delayed-Transition Transfer Switches: Pauses or stops in intermediate position to momentarily disconnect both sources, with transition controlled by programming in the automatic transfer-switch controller. Interlocked to prevent the load from being closed on both sources at the same time.

1. Adjustable Time Delay: For override of normal-source voltage sensing to delay transfer and engine start signals for alternative source. Adjustable from zero to six seconds, and factory set for one second.
2. Sources shall be mechanically and electrically interlocked to prevent closing both sources on the load at the same time.
3. Fully automatic break-before-make operation with center off position.
4. Fully automatic break-before-make operation with transfer when two sources have near zero phase difference.

E. Automatic Closed-Transition Transfer Switches: Connect both sources to load momentarily. Transition is controlled by programming in the automatic transfer-switch controller.

1. Fully automatic make-before-break operation when transferring between two available power sources.
2. Load transfer without interruption, through momentary interconnection of both power sources not exceeding 100 ms.
3. Initiation of No-Interruption Transfer: Controlled by in-phase monitor and sensors confirming both sources are present and acceptable.

   a. Initiation occurs without active control of generator.
   b. Automatic transfer-switch controller takes active control of generator to match frequency, phase angle, and voltage.
   c. Controls ensure that closed-transition load transfer closure occurs only when the two sources are within plus or minus 5 electrical degrees maximum, and plus or minus 5 percent maximum voltage difference.

4. Failure of power source serving load initiates automatic break-before-make transfer.

F. Manual Switch Operation: Under load, with door closed and with either or both sources energized. Transfer time is same as for electrical operation. Control circuit automatically disconnects from electrical operator during manual operation.

G. Manual Switch Operation: Unloaded. Control circuit automatically disconnects from electrical operator during manual operation.

H. Electric **Nonautomatic** Switch Operation: Electrically actuated by push buttons designated "Normal Source" and "Alternative Source." Switch shall be capable of transferring load in either direction with either or both sources energized.

I. Signal-Before-Transfer Contacts: A set of normally open/normally closed dry contacts operates in advance of retransfer to normal source. Interval shall be adjustable from 1 to 30 seconds.

J. Digital Communication Interface: Matched to capability of remote annunciator or annunciator and control panel.

K. Automatic Transfer-Switch Controller Features:

1. Controller operates through a period of loss of control power.
2. Undervoltage Sensing for Each Phase of Normal [**and Alternate**]Source: Sense low phase-to-ground voltage on each phase. Pickup voltage shall be adjustable from 85 to 100 percent of nominal, and dropout voltage shall be adjustable from 75 to 98 percent of pickup value. Factory set for pickup at 90 percent and dropout at 85 percent.
3. Voltage/Frequency Lockout Relay: Prevent premature transfer to generator. Pickup voltage shall be adjustable from 85 to 100 percent of nominal. Factory set for pickup at 90 percent. Pickup frequency shall be adjustable from 90 to 100 percent of nominal. Factory set for pickup at 95 percent.
4. Time Delay for Retransfer to Normal Source: Adjustable from zero to 30 minutes, and factory set for 10 minutes. Override shall automatically defeat delay on loss of voltage or sustained undervoltage of emergency source, provided normal supply has been restored.
5. Test Switch: Simulate normal-source failure.
6. Switch-Position Pilot Lights: Indicate source to which load is connected.
7. Source-Available Indicating Lights: Supervise sources via transfer-switch normal- and emergency-source sensing circuits.

    a. Normal Power Supervision: Green light with nameplate engraved "Normal Source Available."
    b. Emergency Power Supervision: Red light with nameplate engraved "Emergency Source Available."

8. Unassigned Auxiliary Contacts: Two normally open, single-pole, double-throw contacts for each switch position, rated 10 A at 240-V ac.
9. Transfer Override Switch: Overrides automatic retransfer control so transfer switch will remain connected to emergency power source regardless of condition of normal source. Pilot light indicates override status.
10. Engine Starting Contacts: One isolated and normally closed, and one isolated and normally open; rated 10 A at 32-V dc minimum.
11. Engine Shutdown Contacts: Instantaneous; shall initiate shutdown sequence at remote engine-generator controls after retransfer of load to normal source.
12. Engine Shutdown Contacts: Time delay adjustable from zero to five minutes, and factory set for five minutes. Contacts shall initiate shutdown at remote engine-generator controls after retransfer of load to normal source.
13. Engine-Generator Exerciser: Solid-state, programmable-time switch starts engine generator and transfers load to it from normal source for a preset time, then retransfers and shuts down engine after a preset cool-down period. Initiates exercise cycle at preset intervals adjustable from 7 to 30 days. Running periods shall be adjustable from 10 to 30 minutes. Factory settings shall be for 7-day exercise cycle, 20-minute running period, and 5-minute cool-down period. Exerciser features include the following:

    a. Exerciser Transfer Selector Switch: Permits selection of exercise with and without load transfer.
    b. Push-button programming control with digital display of settings.
    c. Integral battery operation of time switch when normal control power is unavailable.

L. Large-Motor-Load Power Transfer:

1. In-Phase Monitor: Factory-wired, internal relay controls transfer so contacts close only when the two sources are synchronized in phase and frequency. Relay shall compare phase relationship and frequency difference between normal and emergency sources and initiate transfer when both sources are within 15 electrical degrees, and only if

transfer can be completed within 60 electrical degrees. Transfer shall be initiated only if both sources are within 2 Hz of nominal frequency and 70 percent or more of nominal voltage.

2. Motor Disconnect and Timing Relay Controls: Designated starters in loss of power scenario shall disconnect motors before transfer and reconnect them selectively at an adjustable time interval after transfer. Control connection to motor starters shall be through wiring external to automatic transfer switch. Provide adjustable time delay between 1 and 60 seconds for reconnecting individual motor loads. Provide relay contacts rated for motor-control circuit inrush and for actual seal currents to be encountered.

3. Programmed Neutral Switch Position: Switch operator with programmed neutral position arranged to provide a midpoint between the two working switch positions, with an intentional, time-controlled pause at midpoint during transfer. Adjustable pause from 0.5 to 30 seconds minimum, and factory set for 0.5 second unless otherwise indicated. Time delay occurs for both transfer directions. Disable pause unless both sources are live.

2.3 MOLDED-CASE-TYPE AUTOMATIC TRANSFER SWITCHES

A. Comply with Level 1 equipment according to NFPA 110.

B. Switch Characteristics: Designed for continuous-duty repetitive transfer of full-rated current between active power sources.

1. Limitation: Switches using contactor-based components are unacceptable.
2. Switch Action: Double throw; mechanically held in both directions.
3. Contacts: Silver composition or silver alloy for load-current switching.
4. Conductor Connectors: Suitable for use with conductor material and sizes.
5. Material: **Tin-plated aluminum**.
6. Main and Neutral Lugs: **Compression** type.
7. Ground Lugs and Bus-Configured Terminators: **Compression** type.
8. Ground bar.
9. Connectors shall be marked for conductor size and type according to UL 1008.

C. Automatic Open-Transition Transfer Switches: Interlocked to prevent the load from being closed on both sources at the same time.

1. Sources shall be mechanically and electrically interlocked to prevent closing both sources on the load at the same time.

D. Automatic Delayed-Transition Transfer Switches: Pauses or stops in intermediate position to momentarily disconnect both sources, with transition controlled by programming in the automatic transfer-switch controller. Interlocked to prevent the load from being closed on both sources at the same time.

1. Adjustable Time Delay: For override of normal-source voltage sensing to delay transfer and engine start signals for alternative source. Adjustable from zero to six seconds, and factory set for one second.
2. Sources shall be mechanically and electrically interlocked to prevent closing both sources on the load at the same time.
3. Fully automatic break-before-make operation with center off position.
4. Fully automatic break-before-make operation with transfer when two sources have near zero phase difference.

E. Automatic Closed-Transition Transfer Switches: Connect both sources to load momentarily. Transition is controlled by programming in the automatic transfer-switch controller.

1. Fully automatic make-before-break operation when transferring between two available power sources.
2. Load transfer without interruption, through momentary interconnection of both power sources not exceeding 100 ms.
3. Initiation of No-Interruption Transfer: Controlled by in-phase monitor and sensors confirming both sources are present and acceptable.

    a. Initiation occurs without active control of generator.
    b. Automatic transfer-switch controller takes active control of generator to match frequency, phase angle, and voltage.
    c. Controls ensure that closed-transition load transfer closure occurs only when the two sources are within plus or minus 5 electrical degrees maximum, and plus or minus 5 percent maximum voltage difference.

4. Failure of power source serving load initiates automatic break-before-make transfer.

F. Manual Switch Operation: Under load, with door closed and with either or both sources energized. Transfer time is same as for electrical operation. Control circuit automatically disconnects from electrical operator during manual operation.

G. Manual Switch Operation: Unloaded. Control circuit automatically disconnects from electrical operator during manual operation.

H. Electric **Nonautomatic** Switch Operation: Electrically actuated by push buttons designated "Normal Source" and "Alternative Source." Switch shall be capable of transferring load in either direction with either or both sources energized.

I. Signal-Before-Transfer Contacts: A set of normally open/normally closed dry contacts operates in advance of retransfer to normal source. Interval shall be adjustable from 1 to 30 seconds.

J. Digital Communication Interface: Matched to capability of remote annunciator or annunciator and control panel.

K. Transfer Switches Based on Molded-Case-Switch Components: Comply with UL 489 and UL 869A.

L. Automatic Transfer-Switch Controller Features:

1. Controller operates through a period of loss of control power.
2. Undervoltage Sensing for Each Phase of Normal Source: Sense low phase-to-ground voltage on each phase. Pickup voltage shall be adjustable from 85 to 100 percent of nominal, and dropout voltage shall be adjustable from 75 to 98 percent of pickup value. Factory set for pickup at 90 percent and dropout at 85 percent.
3. Voltage/Frequency Lockout Relay: Prevent premature transfer to generator. Pickup voltage shall be adjustable from 85 to 100 percent of nominal. Factory set for pickup at 90 percent. Pickup frequency shall be adjustable from 90 to 100 percent of nominal. Factory set for pickup at 95 percent.
4. Time Delay for Retransfer to Normal Source: Adjustable from zero to 30 minutes, and factory set for 10 minutes. Override shall automatically defeat delay on loss of voltage or sustained undervoltage of emergency source, provided normal supply has been restored.
5. Test Switch: Simulate normal-source failure.
6. Switch-Position Pilot Lights: Indicate source to which load is connected.

7. Source-Available Indicating Lights: Supervise sources via transfer-switch normal- and emergency-source sensing circuits.

    a. Normal Power Supervision: Green light with nameplate engraved "Normal Source Available."
    b. Emergency Power Supervision: Red light with nameplate engraved "Emergency Source Available."

8. Unassigned Auxiliary Contacts: Two normally open, single-pole, double-throw contacts for each switch position, rated 10 A at 240-V ac.
9. Transfer Override Switch: Overrides automatic retransfer control so automatic transfer switch will remain connected to emergency power source regardless of condition of normal source. Pilot light indicates override status.
10. Engine Starting Contacts: One isolated and normally closed, and one isolated and normally open; rated 10 A at 32-V dc minimum.
11. Engine Shutdown Contacts: Instantaneous; shall initiate shutdown sequence at remote engine-generator controls after retransfer of load to normal source.
12. Engine Shutdown Contacts: Time delay adjustable from zero to five minutes, and factory set for five minutes. Contacts shall initiate shutdown at remote engine-generator controls after retransfer of load to normal source.
13. Engine-Generator Exerciser: Solid-state, programmable-time switch starts engine generator and transfers load to it from normal source for a preset time, then retransfers and shuts down engine after a preset cool-down period. Initiates exercise cycle at preset intervals adjustable from 7 to 30 days. Running periods shall be adjustable from 10 to 30 minutes. Factory settings shall be for 7-day exercise cycle, 20-minute running period, and 5-minute cool-down period. Exerciser features include the following:

    a. Exerciser Transfer Selector Switch: Permits selection of exercise with and without load transfer.
    b. Push-button programming control with digital display of settings.
    c. Integral battery operation of time switch when normal control power is unavailable.

M. Large-Motor-Load Power Transfer:

1. In-Phase Monitor: Factory-wired, internal relay controls transfer so contacts close only when the two sources are synchronized in phase and frequency. Relay shall compare phase relationship and frequency difference between normal and emergency sources and initiate transfer when both sources are within 15 electrical degrees, and only if transfer can be completed within 60 electrical degrees. Transfer shall be initiated only if both sources are within 2 Hz of nominal frequency and 70 percent or more of nominal voltage.
2. Motor Disconnect and Timing Relay Controls: Designated starters in loss of power scenario shall disconnect motors before transfer and reconnect them selectively at an adjustable time interval after transfer. Control connection to motor starters shall be through wiring external to automatic transfer switch. Provide adjustable time delay between 1 and 60 seconds for reconnecting individual motor loads. Provide relay contacts rated for motor-control circuit inrush and for actual seal currents to be encountered.
3. Programmed Neutral Switch Position: Switch operator with programmed neutral position arranged to provide a midpoint between the two working switch positions, with an intentional, time-controlled pause at midpoint during transfer. Adjustable pause from 0.5 to 30 seconds minimum, and factory set for 0.5 second unless otherwise indicated. Time delay occurs for both transfer directions. Disable pause unless both sources are live.

2.4 NONAUTOMATIC TRANSFER SWITCHES

A. Electrically Operated: Electrically actuated by push buttons designated "Normal Source" and "Alternative Source." Switch shall be capable of transferring load in either direction with either or both sources energized.

B. Manual and Electrically Operated: Electrically actuated by push buttons designated "Normal Source" and "Alternative Source." Manual handle provides quick-make, quick-break manual-switching action. Switch shall be capable of electrically or manually transferring load in either direction with either or both sources energized. Control circuit disconnects from electrical operator during manual operation.

C. Double-Throw Switching Arrangement: Incapable of pauses or intermediate position stops during switching sequence.

D. Pilot Lights: Indicate source to which load is connected.

E. Source-Available Indicating Lights: Supervise sources via transfer-switch normal- and alternative-source sensing circuits.

1. Normal Power Supervision: Green light with nameplate engraved "Normal Source Available."
2. Emergency Power Supervision: Red light with nameplate engraved "Alternative Source Available."

F. Unassigned Auxiliary Contacts: Switch shall have one set of normally closed contacts for each switch position, rated 10 A at 240-V ac.

G. Switch Characteristics: Designed for continuous-duty repetitive transfer of full-rated current between active power sources.

1. Switch Action: Double throw; mechanically held in both directions.
2. Contacts: Silver composition or silver alloy for load-current switching.
3. Conductor Connectors: Suitable for use with conductor material and sizes.
4. Material: **Tin-plated aluminum**.
5. Main and Neutral Lugs: **Compression** type.
6. Ground Lugs and Bus-Configured Terminators: **Compression** type.
7. Ground bar.
8. Connectors shall be marked for conductor size and type according to UL 1008.

2.5 TRANSFER SWITCH ACESSORIES

A. Bypass/Isolation Switches:

1. Source Limitations: Same manufacturer as transfer switch in which installed.
2. Comply with requirements for Level 1 equipment according to NFPA 110.
3. Description: Manual type, arranged to select and connect either source of power directly to load, isolating transfer switch from load and from both power sources. Include the following features for each combined automatic transfer switch and bypass/isolation switch:

a. Means to lock bypass/isolation switch in the position that isolates transfer switch with an arrangement that permits complete electrical testing of transfer switch

while isolated. Interlocks shall prevent transfer-switch operation, except for testing or maintenance, while automatic transfer switch is isolated.

b. Provide means to make power available to transfer-switch control circuit for testing and maintenance purposes.

c. Drawout Arrangement for Transfer Switch: Provide physical separation from live parts and accessibility for testing and maintenance operations. Transfer switch and bypass/isolation switch shall be in isolated compartments.

d. Transition: Provide closed-transition operation when transferring from main transfer switch to bypass/isolation switch on the same power source.

e. Transition: Provide [**open**] [**closed**]-transition operation when transferring between power sources.

f. Bypass/Isolation Switch Current, Voltage, Closing, and Short-Circuit Withstand Ratings: Equal to or greater than those of associated automatic transfer switch, and with same phase arrangement and number of poles.

g. Contact temperatures of bypass/isolation switches shall not exceed those of automatic transfer-switch contacts when they are carrying rated load.

h. Manual Control: Constructed so load bypass and transfer-switch isolation can be performed by one person in no more than two operations in 15 seconds or less. Operating handles shall be externally operated.

i. Automatic and Nonautomatic Control: Automatic transfer-switch controller shall also control the bypass/isolation switch.

j. Legend: Manufacturer's standard legend for control labels and instruction signs shall describe operating instructions.

k. Maintainability: Fabricate to allow convenient removal of major components from front without removing other parts or main power conductors.

4. Interconnection of Bypass/Isolation Switches with Automatic Transfer Switches: Factory-installed copper bus bars; plated at connection points and braced for the indicated available short-circuit current.

B. Remote Annunciator System:

1. Source Limitations: Same manufacturer as transfer switch in which installed.

2. Functional Description: Remote annunciator panel shall annunciate conditions for indicated transfer switches.

3. Annunciation panel display shall include the following indicators:

a. Sources available, as defined by actual pickup and dropout settings of transfer-switch controls.

b. Switch position.

c. Switch in test mode.

d. Failure of communication link.

4. Annunciator Panel: LED-lamp type with audible signal and silencing switch.

a. Indicating Lights: Grouped for each transfer switch monitored.

b. Label each group, indicating transfer switch it monitors, location of switch, and identity of load it serves.

c. Mounting: Flush, modular, steel cabinet unless otherwise indicated.

d. Lamp Test: Push-to-test or lamp-test switch on front panel.

C. Remote Annunciator and Control System:

1. Source Limitations: Same manufacturer as transfer switch in which installed.

2. Include the following functions for indicated transfer switches:

   a. Indication of sources available, as defined by actual pickup and dropout settings of transfer-switch controls.
   b. Indication of switch position.
   c. Indication of switch in test mode.
   d. Indication of failure of digital communication link.
   e. Key-switch or user-code access to control functions of panel.
   f. Control of switch-test initiation.
   g. Control of switch operation in either direction.
   h. Control of time-delay bypass for transfer to normal source.

3. Malfunction of annunciator, annunciation and control panel, or communication link shall not affect functions of automatic transfer switch. In the event of failure of communication link, automatic transfer switch automatically shall revert to standalone, self-contained operation. Automatic transfer-switch sensing, controlling, or operating function shall not depend on remote panel for proper operation.
4. Remote Annunciation and Control Panel: Solid-state components. Include the following features:

   a. Controls and indicating lights grouped together for each transfer switch.
   b. Label each indicating light control group. Indicate transfer switch it controls, location of switch, and load it serves.
   c. Digital Communication Capability: Matched to that of transfer switches supervised.
   d. Mounting: Flush, modular, steel cabinet unless otherwise indicated.

2.6 SOURCE QUALITY CONTROL

A. Factory Tests: Test and inspect components, assembled switches, and associated equipment according to UL 1008. Ensure proper operation. Check transfer time and voltage, frequency, and time-delay settings for compliance with specified requirements. Perform dielectric strength test complying with NEMA ICS 1.

B. Prepare test and inspection reports.

1. For each of the tests required by UL 1008, performed on representative devices, for **emergency** systems. Include results of test for the following conditions:

   a. Overvoltage.
   b. Undervoltage.
   c. Loss of supply voltage.
   d. Reduction of supply voltage.
   e. Alternative supply voltage or frequency is at minimum acceptable values.
   f. Temperature rise.
   g. Dielectric voltage-withstand; before and after short-circuit test.
   h. Overload.
   i. Contact opening.
   j. Endurance.
   k. Short circuit.
   l. Short-time current capability.
   m. Receptacle withstand capability.
   n. Insulating base and supports damage.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Floor-Mounting Switch: Anchor to floor by bolting.

1. Install transfer switches on cast-in-place concrete equipment base(s). Comply with requirements for equipment bases and foundations specified in **Section 03 30 00 "Cast-in-Place Concrete."**
2. Comply with requirements for seismic control devices specified in Section 26 05 48.16 "Seismic Controls for Electrical Systems."
3. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases.
4. Provide workspace and clearances required by NFPA 70.

B. Annunciator and Control Panel Mounting: Flush in wall unless otherwise indicated.

C. Identify components according to Section 26 05 53 "Identification for Electrical Systems."

D. Set field-adjustable intervals and delays, relays, and engine exerciser clock.

E. Comply with NECA 1.

3.2 CONNECTIONS

A. Wiring to Remote Components: Match type and number of cables and conductors to generator sets, **motor controls,** control, and communication requirements of transfer switches as recommended by manufacturer. Increase raceway sizes at no additional cost to Owner if necessary to accommodate required wiring.

B. Wiring Method: Install cables in raceways and cable trays except within electrical enclosures. Conceal raceway and cables except in unfinished spaces.

1. Comply with requirements for raceways and boxes specified in Section 26 05 33 "Raceways and Boxes for Electrical Systems."

C. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii.

D. Ground equipment according to Section 26 05 26 "Grounding and Bonding for Electrical Systems."

E. Connect wiring according to Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables" and Section 27 15 00 "Communications Horizontal Cabling."

F. Route and brace conductors according to manufacturer's written instructions **and Section 26 05 29 "Hangers and Supports for Electrical Systems."** Do not obscure manufacturer's markings and labels.

G. Brace and support equipment according to Section 26 05 48.16 "Seismic Controls for Electrical Systems."

H. Final connections to equipment shall be made with liquidtight, flexible metallic conduit no more than 18 inches (457 mm) in length.

3.3 FIELD QUALITY CONTROL

A. Testing Agency: [**Owner will engage**] [**Engage**] a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

C. Perform the following tests and inspections **with the assistance of a factory-authorized service representative**:

1. After installing equipment, test for compliance with requirements according to NETA ATS.
2. Visual and Mechanical Inspection:

a. Compare equipment nameplate data with Drawings and Specifications.
b. Inspect physical and mechanical condition.
c. Inspect anchorage, alignment, grounding, and required clearances.
d. Verify that the unit is clean.
e. Verify appropriate lubrication on moving current-carrying parts and on moving and sliding surfaces.
f. Verify that manual transfer warnings are attached and visible.
g. Verify tightness of all control connections.
h. Inspect bolted electrical connections for high resistance using one of the following methods, or both:

1) Use of low-resistance ohmmeter.
2) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method according to manufacturer's published data.

i. Perform manual transfer operation.
j. Verify positive mechanical interlocking between normal and alternate sources.
k. Perform visual and mechanical inspection of surge arresters.
l. Inspect control power transformers.

1) Inspect for physical damage, cracked insulation, broken leads, tightness of connections, defective wiring, and overall general condition.
2) Verify that primary and secondary fuse or circuit-breaker ratings match Drawings.
3) Verify correct functioning of drawout disconnecting contacts, grounding contacts, and interlocks.

3. Electrical Tests:

a. Perform insulation-resistance tests on all control wiring with respect to ground.

b. Perform a contact/pole-resistance test. Compare measured values with manufacturer's acceptable values.
c. Verify settings and operation of control devices.
d. Calibrate and set all relays and timers.
e. Verify phase rotation, phasing, and synchronized operation.
f. Perform automatic transfer tests.
g. Verify correct operation and timing of the following functions:

1) Normal source voltage-sensing and frequency-sensing relays.
2) Engine start sequence.
3) Time delay on transfer.

4) Alternative source voltage-sensing and frequency-sensing relays.
5) Automatic transfer operation.
6) Interlocks and limit switch function.
7) Time delay and retransfer on normal power restoration.
8) Engine cool-down and shutdown feature.

4. Measure insulation resistance phase-to-phase and phase-to-ground with insulation-resistance tester. Include external annunciation and control circuits. Use test voltages and procedure recommended by manufacturer. Comply with manufacturer's specified minimum resistance.

   a. Check for electrical continuity of circuits and for short circuits.
   b. Inspect for physical damage, proper installation and connection, and integrity of barriers, covers, and safety features.
   c. Verify that manual transfer warnings are properly placed.
   d. Perform manual transfer operation.

5. After energizing circuits, perform each electrical test for transfer switches stated in NETA ATS and demonstrate interlocking sequence and operational function for each switch at least three times.

   a. Simulate power failures of normal source to automatic transfer switches and retransfer from emergency source with normal source available.
   b. Simulate loss of phase-to-ground voltage for each phase of normal source.
   c. Verify time-delay settings.
   d. Verify pickup and dropout voltages by data readout or inspection of control settings.
   e. Test bypass/isolation unit functional modes and related automatic transfer-switch operations.
   f. Perform contact-resistance test across main contacts and correct values exceeding 500 microhms and values for one pole deviating by more than 50 percent from other poles.
   g. Verify proper sequence and correct timing of automatic engine starting, transfer time delay, retransfer time delay on restoration of normal power, and engine cool-down and shutdown.

6. Ground-Fault Tests: Coordinate with testing of ground-fault protective devices for power delivery from both sources.

   a. Verify grounding connections and locations and ratings of sensors.

D. Coordinate tests with tests of generator and run them concurrently.

E. Report results of tests and inspections in writing. Record adjustable relay settings and measured insulation and contact resistances and time delays. Attach a label or tag to each tested component indicating satisfactory completion of tests.

F. Transfer switches will be considered defective if they do not pass tests and inspections.

G. Remove and replace malfunctioning units and retest as specified above.

H. Prepare test and inspection reports.

I. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each switch. Remove all access panels so joints and connections are accessible to portable scanner.

1. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
2. Record of Infrared Scanning: Prepare a certified report that identifies switches checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.
3. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each switch 11 months after date of Substantial Completion.

3.4 DEMONSTRATION

A. **Engage a factory-authorized service representative to train** Owner's maintenance personnel to adjust, operate, and maintain transfer switches and related equipment.

B. Training shall include testing ground-fault protective devices and instructions to determine when the ground-fault system shall be retested. Include instructions on where ground-fault sensors are located and how to avoid negating the ground-fault protection scheme during testing and circuit modifications.

C. Coordinate this training with that for generator equipment.

END OF SECTION 26 36 00

SECTION 26 41 13 - LIGHTNING PROTECTION FOR STRUCTURES

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 lightning protection system for ordinary structures.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings:

1. Include layouts of the lightning protection system, with details of the components to be used in the installation.
2. Include raceway locations needed for the installation of conductors.
3. Details of air terminals, ground rods, ground rings, conductor supports, splices, and terminations, including concealment requirements.
4. Include roof attachment details, coordinated with roof installation.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Lightning protection system Shop Drawings, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Lightning protection cabling attachments to roofing systems and accessories.
2. Lightning protection strike termination device attachment to roofing systems, coordinated with the roofing system manufacturer.
3. Lightning protection system components penetrating roofing and moisture protection systems and system components, coordinated with the roofing system manufacturer.

B. Qualification Data: For Installer.

C. Product Certificates: For each type of roof adhesive for attaching the roof-mounted air terminal assemblies, approved by the roofing-material manufacturer.

D. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For lightning protection system to include in maintenance manuals.

1. In addition to items specified in Section017823 "Operation and Maintenance Data," include the following:

    a. Dimensioned site plan showing dimensioned route of the ground loop conductor and the ground rod locations. Comply with requirements of Section017839 “Project Record Documents."
    b. A system testing and inspection record, listing the results of inspections and ground resistance tests, as recommended by NFPA 780, Annex D.

B. Completion Certificate:

1. LPI Master Certificate.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: LPI Master Installer.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

1. East Coast Lightning Equipment Inc.
2. ERICO International Corporation.
3. Harger.
4. Heary Bros. Lightning Protection Co. Inc.
5. Independent Protection Co.
6. Preferred Lightning Protection.
7. Robbins Lightning, Inc.
8. Thompson Lightning Protection, Inc.

2.2 PERFORMANCE REQUIREMENTS

A. NFPA Lightning Protection Standard: Comply with NFPA 780 requirements for Class I buildings.

B. Lightning Protection Components, Devices, and Accessories: Listed and labeled by a qualified testing agency as complying with UL 96, and marked for intended location and application.

2.3 MATERIALS

A. Air Terminals:

1. Aluminum unless otherwise indicated.
2. 3/8-inch diameter by 12-inches long.
3. Rounded tip.
4. Integral base support.

B. Class 1 Main Conductors:

1. Aluminum: 98,600 circular mils in diameter.

C. Secondary Conductors:

1. Aluminum: 41,400 circular mils in diameter.

D. Ground Loop Conductor: Stranded copper.

E. Ground Rods:

1. Material: Copper-clad steel.
2. Diameter: 5/8-inch.
3. Rods shall be not less than 120-inches long.

F. Conductor Splices and Connectors: Compression fittings that are installed with hydraulically operated tools, or exothermic welds, approved for use with the class type.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install lightning protection components and systems according to NFPA 780.

B. Install conductors with direct paths from air terminals to ground connections. Avoid bends less than 90 degrees and 8-inches in radius and narrow loops.

C. Conceal conductors within normal view from exterior locations at grade within 200-feet of building. Comply with requirements for concealed installations in NFPA 780.

1. Roof penetrations required for down conductors and connections to structural-steel framework shall be made using listed through-roof fitting and connector assemblies with solid rods and appropriate roof flashings. Use materials approved by the roofing manufacturer for the purpose. Conform to the methods and materials required at roofing penetrations of the lightning protection components to ensure compatibility with the roofing specifications and warranty.
2. Install conduit where necessary to comply with conductor concealment requirements.
3. Air Terminals on Single-Ply Membrane Roofing: Comply with adhesive manufacturer's written instructions.

D. Ground Ring Electrode: The conductor shall be not less than the main-size lightning conductor.

3.2 CONNECTIONS

A. Aboveground concealed connections, and connections in earth or concrete, shall be done by exothermic welds or by high-compression fittings listed for the purpose.

B. Aboveground exposed connections shall be done using the following types of connectors, listed and labeled for the purpose: bolted connectors.

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 bonding so vibration is not transmitted to rigidly mounted equipment.

3.3 CORROSION PROTECTION

A. Do not combine materials that can form an electrolytic couple that will accelerate corrosion in the presence of moisture unless moisture is permanently excluded from junction of such materials.

B. Use conductors with protective coatings where conditions would cause deterioration or corrosion of conductors.

3.4 FIELD QUALITY CONTROL

A. Special Inspections: Engage a qualified special inspector to perform the following special inspections:

1. Perform inspections as required to obtain an LPI certification.

B. Prepare test and inspection reports and certificates.

END OF SECTION 26 41 13

SECTION 26 51 19 - LED INTERIOR LIGHTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes:

1. Interior LED luminaires.
2. Exterior, building mounted LED luminaires.
3. Emergency lighting units.
4. Exit signs.
5. Luminaire supports.

B. Related Requirements:

1. Section 26 09 23 "Lighting Control Devices" for automatic control of lighting, including time switches, photoelectric relays, occupancy sensors, and multipole lighting relays and contactors.

1.3 DEFINITIONS

A. CCT: Correlated color temperature.

B. CRI: Color Rendering Index.

C. Emergency Lighting Unit: A lighting unit with internal or external emergency battery powered supply and the means for controlling and charging the battery and unit operation.

D. Fixture: See "Luminaire."

E. IP: International Protection or Ingress Protection Rating.

F. LED: Light-emitting diode.

G. Lumen: Measured output of lamp and luminaire, or both.

H. Luminaire: Complete lighting unit, including lamp, reflector, driver and housing.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Arrange in order of luminaire designation.

2. Include data on features, accessories, and finishes.
3. Include physical description and dimensions of luminaires.
4. Include emergency lighting units, including batteries and chargers.
5. Include life, output (lumens, CCT, and CRI), and energy-efficiency data.
6. Include the Spectral Power Distribution (SPD) of the radiant power emitted by the light source at each wavelength or band of wavelengths in the visible region of the electromagnetic spectrum (360 to 770 nanometers). The SPD will not be required for exit signs.
7. Photometric data and adjustment factors based on laboratory tests IES LM-79 and IES LM-80.

    a. Manufacturers' Certified Data: Photometric data certified by manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products.
    b. Testing Agency Certified Data: For indicated luminaires, photometric data certified by a qualified independent testing agency. Photometric data for remaining luminaires shall be certified by manufacturer.

B. Product Schedule: For luminaires and lamps. Use same designations indicated in the Luminaire Schedule on the Drawings.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plan(s) and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Luminaires.
2. Suspended ceiling components.
3. Partitions and millwork that penetrate the ceiling or extend to within 12-inches of the plane of the luminaires.
4. Structural members to which equipment and luminaires will be attached.
5. Initial access modules for acoustical tile, including size and locations.
6. Items penetrating finished ceiling, including the following:

    a. Other luminaires.
    b. Air outlets and inlets.
    c. Speakers.
    d. Sprinklers.
    e. Access panels.
    f. Ceiling-mounted projectors.

7. Moldings.

B. Qualification Data: For testing laboratory providing photometric data for luminaires.

C. Product Certificates: For each type of luminaire.

D. Product Test Reports: For each type of luminaire, for tests performed by a qualified testing agency.

E. Sample warranty.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For luminaires and lighting systems to include in operation and maintenance manuals.

1.7 QUALITY ASSURANCE

A. Luminaire Photometric Data Testing Laboratory Qualifications: Luminaire manufacturer's laboratory that is accredited under the NVLAP for Energy Efficient Lighting Products.

B. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by an independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910.7, accredited under the NVLAP for Energy Efficient Lighting Products, and complying with the applicable IES testing standards.

C. Provide luminaires from a single manufacturer for each luminaire type.

D. Each luminaire type shall be binned within a three-step MacAdam Ellipse to ensure color consistency among luminaires.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering before shipping.

1.9 WARRANTY

A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion. Full warranty shall apply for batteries the entire warranty period.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR LUMINAIRES

A. Manufacturers: Refer to Luminaire Schedule on the Drawings for basis of design manufacturer and model numbers.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. NRTL Compliance: Fabricate and label emergency lighting units, exit signs, and batteries to comply with UL 924 and NFPA 101.

D. Environmental Limitations

1. Ambient Temperature: 5 to 104°F.
2. Ambient Storage Temperature: -4 to 140°F.

3. Relative Humidity: Zero to 95 percent.
4. Altitude: Sea level to 1000-feet.

E. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps. Locate labels where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.

1. Label shall include the following lamp characteristics:

a. "USE ONLY" and include specific lamp type.
b. Lamp diameter, shape, size, wattage, and coating.
c. CCT and CRI.

F. Recessed luminaires shall comply with NEMA LE 4.

2.2 GENERAL REQUIREMENTS FOR EMERGENCY LIGHTING

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. NRTL Compliance: Fabricate and label emergency lighting units, exit signs, and batteries to comply with UL 924.

C. Comply with NFPA 70 and NFPA 101.

D. Comply with NEMA LE 4 for recessed luminaires.

E. Internal Type Emergency Power Unit: Self-contained, modular, battery-inverter unit, factory mounted within luminaire body and compatible with driver.

1. 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.
2. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:

a. Ambient Temperature: Less than 0ºF or exceeding 104ºF, with an average value exceeding 95ºF over a 24-hour period.
b. Ambient Storage Temperature: Not less than minus 4ºF and not exceeding 140ºF.
c. Humidity: More than 95 percent (condensing).
d. Altitude: Exceeding 3300 feet.

3. Test Push-Button and Indicator Light: Visible and accessible without opening luminaire 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.

4. Battery: Sealed, maintenance-free, nickel-cadmium type.
5. Charger: Fully automatic, solid-state, constant-current type with sealed power transfer relay.

2.3 EMERGENCY LIGHTING

A. Emergency Luminaires, Self-contained:

1. Refer to Luminaire Schedule on the Drawings for basis of design manufacturer and model numbers, with the following additional features:

   a. Operating at nominal voltage of 120/277V ac.
   b. Internal emergency power unit.
   c. Rated for installation in damp locations, and for sealed and gasketed luminaires in wet locations.
   d. UL 94 V-0 flame rating.

B. Emergency Lighting Unit, Self-contained:

1. Refer to Luminaire Schedule on the Drawings for basis of design manufacturer and model numbers.
2. Operating at nominal voltage of 120/277 V ac.
3. Wall mount with universal junction box adaptor.
4. UV stable thermoplastic housing, rated for damp locations.
5. Two LED lamp heads.
6. Internal emergency power unit.

2.4 EXIT SIGNS

A. General Requirements for Exit Signs: Comply with UL 924; for sign colors, visibility, luminance, and lettering size, comply with authorities having jurisdiction.

B. Internally Lighted Signs:

1. Refer to Luminaire Schedule on the Drawings for basis of design manufacturer and model numbers.
2. Operating at nominal voltage of 120/277 V ac.
3. Lamps for AC Operation: LEDs; 50,000 hours minimum rated lamp life.
4. Self-Powered Exit Signs (Battery Type): Internal emergency power unit.

2.5 MATERIALS

A. Metal Parts:

1. Free of burrs and sharp corners and edges.
2. Sheet metal components shall be steel unless otherwise indicated.
3. Form and support to prevent warping and sagging.

B. Steel:

1. ASTM A 36/A 36M for carbon structural steel.
2. ASTM A 568/A 568M for sheet steel.

C. Stainless Steel:

1. 1. Manufacturer's standard grade.
2. 2. Manufacturer's standard type, ASTM A 240/240 M.

D. Galvanized Steel: ASTM A 653/A 653M.

E. Aluminum: ASTM B 209.

F. Doors, Frames, and Other Internal Access:

1. Smooth operating, free of light leakage under operating conditions.
2. Designed to permit relamping without use of tools.
3. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.

G. Housings:

1. Extruded aluminum housing and heat sink.
2. Clear, powder coat finish.

H. Conduit: Rigid galvanized steel, Electrical metallic tubing, Flexible metallic conduit, minimum ¾-inch in diameter.

2.6 METAL FINISHES

A. Variations in finishes are unacceptable in the same piece. Variations in finishes of adjoining components are acceptable if they are within the range of approved Samples and if they can be and are assembled or installed to minimize contrast.

2.7 LUMINAIRE SUPPORT

A. Comply with requirements in Section 26 05 29 "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 luminaire.

C. Wires: ASTM A 641/A 641 M, Class 3, soft temper, zinc-coated steel, 12 gage.

D. Rod Hangers: 3/16-inch minimum diameter, cadmium-plated, threaded steel rod.

PART 3 - EXECUTION

3.1 EXAMINATION

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

B. Examine roughing-in for luminaire to verify actual locations of luminaire and electrical connections before luminaire installation.

C. Examine walls, floors, roofs, and ceilings for suitable conditions where luminaires will be installed.

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

3.2 INSTALLATION

A. Comply with NECA 1.

B. Install luminaires level, plumb, and square with ceilings and walls unless otherwise indicated.

C. Supports:

1. Sized and rated for luminaire weight.
2. Able to maintain luminaire position after cleaning and relamping.
3. Provide support for luminaire without causing deflection of ceiling or wall.
4. Luminaire-mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire weight and a vertical force of 400 percent of luminaire weight.

D. Flush-Mounted Luminaires:

1. Secured to outlet box.
2. Attached to ceiling structural members at four points equally spaced around circumference of luminaire.
3. Trim ring flush with finished surface.

E. Wall-Mounted Luminaires:

1. Attached to structural members in walls.
2. Do not attach luminaires directly to gypsum board.

F. Suspended Luminaires:

1. Ceiling Mount:

a. Two 5/32-inch diameter aircraft cable supports adjustable to 10-feet in length.
b. Pendant mount with 5/32-inch diameter aircraft cable supports adjustable to 10-feet.

2. Pendants and Rods: Where longer than 48-inches, brace to limit swinging.
3. Stem-Mounted, Single-Unit Luminaires: Suspend with twin-stem hangers. Support with approved outlet box and accessories that hold stem and provide damping of luminaire oscillations. Support outlet box vertically to building structure using approved devices.
4. Continuous Rows of Luminaires: Use tubing or stem for wiring at one point, and tubing or rod for suspension for each unit length of luminaire chassis, including one at each end.
5. Do not use ceiling grid as support for pendant luminaires. Connect support wires or rods to building structure.

G. Ceiling-Grid-Mounted Luminaires:

1. Secure to any required outlet box.
2. Secure luminaire to the luminaire opening using approved fasteners in a minimum of four locations, spaced near corners of luminaire.
3. Use approved devices and support components to connect luminaire to ceiling grid and building structure in a minimum of four locations, spaced near corners of luminaire.

H. Comply with requirements in Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables" for wiring connections.

3.3 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems."

3.4 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.
2. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery power and retransfer to normal.

B. Luminaire will be considered defective if it does not pass operation tests and inspections.

C. Prepare test and inspection reports.

3.5 STARTUP SERVICE

A. Perform startup service:

1. Charge batteries minimum of one hour and depress switch to conduct short-duration test.
2. Charge batteries minimum of 24 hours and conduct one-hour discharge test.

3.6 ADJUSTING

A. Adjustments: Within 12 months of date of Substantial Completion, provide on-site visit to do the following:

1. Inspect all luminaires. Replace, batteries, signs, or luminaires that are defective.

   a. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.

2. Conduct short-duration tests on all emergency lighting.

END OF SECTION 26 51 19

SECTION 26 56 19 – LED EXTERIOR LIGHTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Exterior solid-state luminaires that are designed for and exclusively use LED lamp technology.
2. Luminaire supports.

1.3 DEFINITIONS

A. CCT: Correlated color temperature.

B. CRI: Color rendering index.

C. Fixture: See "Luminaire."

D. IP: International Protection or Ingress Protection Rating.

E. Lumen: Measured output of lamp and luminaire, or both.

F. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of luminaire.

1. Arrange in order of luminaire designation.
2. Include data on features, accessories, and finishes.
3. Include physical description and dimensions of luminaire.
4. Lamps, include life, output (lumens, CCT, and CRI), and energy-efficiency data.
5. Photometric data and adjustment factors based on laboratory tests, complying with IES LM-79 and IES LM-80.

   a. Manufacturer's Certified Data: Photometric data certified by manufacturer's laboratory with a current accreditation under the NVLAP for Energy Efficient Lighting Products.
   b. Testing Agency Certified Data: For indicated luminaires, photometric data certified by a qualified independent testing agency. Photometric data for remaining luminaires shall be certified by manufacturer.

6. Wiring diagrams for power, control, and signal wiring.
7. Means of attaching luminaires to supports and indication that the attachment is suitable for components involved.

B. Shop Drawings: For nonstandard or custom luminaires.

1. Include plans, elevations, sections, and mounting and attachment details.
2. Include details of luminaire assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include diagrams for power, signal, and control wiring.

C. Product Schedule: For luminaires and lamps. Use same designations indicated on Drawings.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Luminaires.
2. Structural members to which [equipment] [and] luminaires will be attached.
3. Underground utilities and structures.
4. Existing underground utilities and structures.
5. Above-grade utilities and structures.
6. Existing above-grade utilities and structures.
7. Building features.
8. Vertical and horizontal information.

B. Qualification Data: For testing laboratory providing photometric data for luminaires.

C. Product Certificates: For each type of the following:

1. Luminaire.

D. Product Test Reports: For each luminaire, for tests performed by manufacturer and witnessed by a qualified testing agency.

E. Source quality-control reports.

F. Sample warranty.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For luminaires to include in operation and maintenance manuals.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Glass, Acrylic, and Plastic Lenses, Covers, and Other Optical Parts: One of each type and rating installed.

2. Diffusers and Lenses: One of each type and rating installed.
3. Globes and Guards: One of each type and rating installed.

1.8 QUALITY ASSURANCE

A. Luminaire Photometric Data Testing Laboratory Qualifications: Luminaire manufacturers' laboratory that is accredited under the NVLAP for Energy Efficient Lighting Products.

B. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by an independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910.7, accredited under the NVLAP for Energy Efficient Lighting Products and complying with applicable IES testing standards.

C. Provide luminaires from a single manufacturer for each luminaire type.

D. Each luminaire type shall be binned within a three-step MacAdam Ellipse to ensure color consistency among luminaires.

E. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering prior to shipping.

1.10 FIELD CONDITIONS

A. Verify existing and proposed utility structures prior to the start of work associated with luminaire installation.

B. Mark locations of exterior luminaires for approval by Architect prior to the start of luminaire installation.

1.11 WARRANTY

A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures, including luminaire support components.
b. Faulty operation of luminaires and accessories.
c. Deterioration of metals, metal finishes, and other materials beyond normal weathering.

2. Warranty Period: 2-years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 LUMINAIRE REQUIREMENTS

A. Manufacturers: Refer to Luminaire Schedule on the Drawings for basis of design manufacturer and model numbers.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. NRTL Compliance: Luminaires shall be listed and labeled for indicated class and division of hazard by an NRTL.

D. FM Global Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by FM Global.

E. UL Compliance: Comply with UL 1598 and listed for wet location.

F. CRI of minimum 90. CCT of [3000 K] [3500 K].

G. L70 lamp life of 50,000 hours.

H. Lamps dimmable from 100 percent to 1 percent of maximum light output.

I. Internal driver.

J. Nominal Operating Voltage: [120 V] [208 V] [277 V].

K. In-line Fusing: On the primary for each luminaire.

L. Lamp Rating: Lamp marked for outdoor use.

M. Source Limitations: For luminaires, obtain each color, grade, finish, type, and variety of luminaire from single source with resources to provide products of consistent quality in appearance and physical properties.

2.2 MATERIALS

A. Metal Parts: Free of burrs and sharp corners and edges.

B. Sheet Metal Components: Corrosion-resistant aluminum. Form and support to prevent warping and sagging.

C. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position. Doors shall be removable for cleaning or replacing lenses.

D. Diffusers and Globes:

1. Acrylic Diffusers: 100% virgin acrylic plastic, with high resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.

2. Glass: Annealed crystal glass unless otherwise indicated.

3. Lens Thickness: At least 0.125-inch minimum unless otherwise indicated.

E. Lens and Refractor Gaskets: Use heat and aging-resistant resilient gaskets to seal and cushion lenses and refractors in luminaire doors.

F. Reflecting surfaces shall have minimum reflectance as follows unless otherwise indicated:

1. White Surfaces: 85%.
2. Specular Surfaces: 83%.
3. Diffusing Specular Surfaces: 75%.

G. Housings:

1. Rigidly formed, weather and light-tight enclosure that will not warp, sag, or deform in use.
2. Provide filter/breather for enclosed luminaires.

H. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps. Labels shall be located where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.

1. Label shall include the following lamp characteristics:

a. "USE ONLY" and include specific lamp type.
b. Lamp diameter, shape, size, wattage and coating.
c. CCT and CRI for all luminaires.

2.3 FINISHES

A. Variations in Finishes: Noticeable variations in same piece are unacceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved variations and are assembled or installed to minimize contrast.

B. Luminaire Finish: Manufacturer's standard paint applied to factory-assembled and tested luminaire before shipping. Where indicated, match finish process and color of pole or support materials.

C. Factory-Applied Finish for Aluminum Luminaires: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

1. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.

2. Natural Satin Finish: Provide fine, directional, medium satin polish (AA-M32); buff complying with AA-M20 requirements; and seal aluminum surfaces with clear, hard-coat wax.
3. Class I, Clear-Anodic Finish: AA-M32C22A41 (Mechanical Finish: Medium satin; Chemical Finish: Etched, medium matte; Anodic Coating: Architectural Class I, clear coating 0.018 mm or thicker) complying with AAMA 611.
4. Class I, Color-Anodic Finish: AA-M32C22A42/A44 (Mechanical Finish: Medium satin; Chemical Finish: Etched, medium matte; Anodic Coating: Architectural Class I, integrally colored or electrolytically deposited color coating 0.018 mm or thicker), complying with AAMA 611.

D. Factory-Applied Finish for Steel Luminaires: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

1. Surface Preparation: Clean surfaces to comply with SSPC-SP 1, to remove dirt, oil, grease, and other contaminants that could impair paint bond. Grind welds and polish surfaces to a smooth, even finish. Remove mill scale and rust, if present, from uncoated steel, complying with SSPC-SP 5/NACE No. 1 or SSPC-SP 8.
2. Exterior Surfaces: Manufacturer's standard finish consisting of one or more coats of primer and two finish coats of high-gloss, high-build polyurethane enamel.

a. Color: As selected by Architect from manufacturer's full range.

2.4 LUMINAIRE SUPPORT COMPONENTS

A. Comply with requirements in Section 26 05 29 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.

PART 3 - EXECUTION

3.1 EXAMINATION

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

B. Examine roughing-in for luminaire electrical conduit to verify actual locations of conduit connections before luminaire installation.

C. Examine walls, roofs, canopy ceilings and overhang ceilings for suitable conditions where luminaires will be installed.

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

3.2 TEMPORARY LIGHTING

A. If approved by the Architect, use selected permanent luminaires for temporary lighting. When construction is substantially complete, clean luminaires used for temporary lighting and install new lamps.

3.3 GENERAL INSTALLATION REQUIREMENTS

A. Comply with NECA 1.

B. Fasten luminaire to structural support.

C. Supports:

1. Sized and rated for luminaire weight.
2. Able to maintain luminaire position after cleaning and relamping.
3. Support luminaires without causing deflection of finished surface.

4. Luminaire-mounting devices shall be capable of supporting a horizontal force of 100% of luminaire weight and a vertical force of 400% of luminaire weight.

D. Wall-Mounted Luminaire Support:

1. Attached to structural members in walls.

E. Wiring Method: Install cables in raceways. Conceal raceways and cables.

F. Install luminaires level, plumb, and square with finished grade unless otherwise indicated.

G. Coordinate layout and installation of luminaires with other construction.

H. Adjust luminaires that require field adjustment or aiming. Include adjustment of photoelectric device to prevent false operation of relay by artificial light sources, favoring a north orientation.

I. Comply with requirements in Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables" and 26 05 33 "Raceways and Boxes for Electrical Systems" for wiring connections and wiring methods.

3.4 BOLLARD LUMINAIRE INSTALLATION:

A. Align units for optimum directional alignment of light distribution.

1. Install on concrete base with top 4-inches above finished grade or surface at luminaire location. Cast conduit into base, and shape base to match shape of bollard base. Finish by troweling and rubbing smooth. Concrete materials, installation, and finishing are specified in Section 03 30 00 "Cast-in-Place Concrete."

3.5 INSTALLATION OF INDIVIDUAL GROUND-MOUNTED LUMINAIRES

A. Aim as indicated on Drawings.

B. Install on concrete base with top as specified on drawings above finished grade or surface at luminaire location. Cast conduit into base, and finish by troweling and rubbing smooth. Concrete materials, installation, and finishing are specified in Section 03 30 00 "Cast-in-Place Concrete."

3.6 CORROSION PREVENTION

A. Aluminum: Do not use in contact with earth or concrete. When in direct contact with a dissimilar metal, protect aluminum by insulating fittings or treatment.

B. Steel Conduits: Comply with Section 26 05 33 "Raceways and Boxes for Electrical Systems." In concrete foundations, wrap conduit with 0.010-inch thick, pipe-wrapping plastic tape applied with a 50% overlap.

3.7 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems."

3.8 FIELD QUALITY CONTROL

A. Inspect each installed luminaire for damage. Replace damaged luminaires and components.

B. Perform the following tests and inspections:

1. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.

C. Illumination Tests:

1. Measure light intensities at night. Use photometers with calibration referenced to NIST standards. Comply with the following IES testing guide(s):

a. IES LM-5.
b. IES LM-50.
c. IES LM-52.
d. IES LM-64.
e. IES LM-72.

D. Luminaire will be considered defective if it does not pass tests and inspections.

E. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.

3.9 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain luminaires.

3.10 ADJUSTING

A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting the direction of aim of luminaires to suit occupied conditions. Make up to two visits to Project during other-than-normal hours for this purpose. Some of this work may be required during hours of darkness.

1. During adjustment visits, inspect all luminaires. Replace lamps or luminaires that are defective.
2. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.
3. Adjust the aim of luminaires in the presence of the Architect.

END OF SECTION 26 56 19

SECTION 27 05 00
COMMON WORK RESULTS FOR COMMUNICATIONS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Summary

B. Related Documents

C. Reference Standards And Codes

D. Administrative Requirements

E. Work Results - Description Of Project

F. Proposal Submittals

G. Submittals For Project Record

H. Equipment Relocation And System Startup

I. Sequencing And Scheduling

J. Quality Assurance - Contractor Qualifications

K. Product Schedule

L. Warranty

M. Delivery, Storage, And Handling

N. Product Quality Assurance

O. Site Conditions

P. Examination

Q. Preparation

R. Demolition / Removal

S. Firestopping

T. Construction Waste Management

U. Labeling

V. Closeout Activities

1.2 SUMMARY

A. This document identifies the design and specification requirements for a complete and functional communications cable plant to be performed for Galveston County. The communications cable plant as specified herein will support the voice, data, AV connectivity and various other low voltage signaling and control devices.

B. The technology infrastructure will be compliant with the latest versions of the TIA/EIA 568-B Series Commercial Building Telecommunications Cabling Standards and Galveston County adopted cabling standards.

C. The Architectural Plans and Specifications, General Conditions, Supplementary General Conditions and other requirements of Division 1, the Mechanical Plans and Specifications, the Electrical Plans and Specifications, and the Communications Plans may apply to the work specified in the Division 27 Sections, and shall be complied with in every respect. The

Contractor shall examine all of these documents, which make up the Contract Documents, and shall coordinate them with all communications work on the Communications plans and in the Division 27 specifications.

D. All work associated with Telecommunication and Equipment Rooms shall comply with the National Electrical Code, state and local building codes. The guidelines developed by ANSI/TIA/EIA and BICSI shall be followed in both design and construction.

E. Contract Documents: Drawings and specifications are to be used in conjunction with one another and to supplement one another. In general the specifications determine the nature and quality of the materials, and the drawings establish the quantities, details, and give characteristics of performance that should be adhered to in the installation of the communications system components. If there is an apparent conflict between the drawings and specifications, the items with the greater quantity or quality shall be estimated upon and installed. Clarification with the Owner, or their designated representative, about these items shall be made prior to bid response.

F. The Architect may at any time, by written order, make changes within the general scope of any contract resulting from this proposal document. If such changes expand, reduce, change or modify the scope of work, the price for the change shall be increased or decreased at the unit prices set forth in the Unit Pricing Section, and the amount shall be deducted from, or added to, the sale price of the system to the Owner. No costs will be added to the project without prior written approval from the Architect.

1.3 RELATED DOCUMENTS

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

B. Related Division 27 Sections include:
1. 27 05 26 Grounding and Bonding
2. 27 05 28 Pathways for Communications Systems
3. 27 05 43 Underground Duct and Raceways
4. 27 05 53 Identification for Communications Systems
5. 27 11 00 Communications Equipment Room Fittings
6. 27 13 00 Communications Backbone Cabling
7. 27 15 00 Communications Horizontal Cabling
8. 27 16 19 Patch Cords, Station Cords,& Cross-Connect Wire
9. 27 20 00 Data Communications Equipment
10. 27 30 00 Voice Communications Equipment

1.4 AGENCIES, REFERENCE STANDARDS AND CODES

A. Agencies
1. ANSI American National Standards Institute
2. BICSI Building Industry Consulting Service International
3. EIA Electronic Industries Association
4. FCC Federal Communications Commission
5. FOTP Fiber Optic Testing Procedures
6. IEEE Institute of Electrical and Electronic Engineers, Inc.
7. NBC National Building Code
8. NFPA National Fire Protection Agency
9. NEC National Electrical Code
10. TIA Telecommunications Industry Association
11. UL Underwriters Laboratories
12. TAC-State of Texas Department of Information Resources:
http://info.sos.state.tx.us/pls/pub/readtac$ext.ViewTAC?tac_view=4&ti=1&pt=10&ch=208

B. Codes and Standards (Latest issue and addenda)

1. ADA Standards for Accessible Design 28 CFR Part 36
2. American Society for Testing Materials (ASTM)*
3. ANSI/TIA/EIA-568-B.1 - Commercial Building Telecommunications Cabling Standard*
4. ANSI/TIA/EIA-568-B.2 - Commercial Building Telecommunications Cabling Standard*
5. ANSI/TIA/EIA-568-B.3 - Optical Fiber Cabling Components Standard*
6. ANSI/TIA/EIA-569 - Commercial Building Standard for Telecommunications Pathways and Spaces*
7. ANSI/TIA/EIA-606-C - Administration Standard for Commercial Telecommunications Infrastructures, June 21, 2017*
8. ANSI/TIA/EIA J-STD-607-C, Commercial Building. Grounding/Bounding Requirements-Joint Standard for Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications, 2015*
9. ANSI/TIA/EIA-758-B - Customer-owned Outside Plant Telecommunications Infrastructure Standard, May 2012*
10. BICSI TDM, Cabling Installation, LAN Design, and Customer-Owned Outside Plant Manuals-Latest Editions
11. International Standards Organization/International Electrotechnical Commission (ISO/IEC) IS 11801, 2017*
12. National Electric Code (NEC), Latest Issue
13. National Electrical Manufacturers Association (NEMA)*
14. OSHA - U.S. Department of Labor Occupational Safety & Health Administration
15. UL - Underwriters Laboratories (UL) Cable Certification and Follow Up Program*

C. Acronyms and Abbreviations

1. ADA Americans with Disabilities Act
2. AKA also known as
3. ANSI American National Standards Institute
4. AP Access Provider
5. ASTM American Society for Testing and Materials
6. AWG American Wire Gauge
7. BICSI Building Industry Consulting Services International
8. CATV community antenna television
9. CO-OSP customer owned outside plant
10. EF entrance facility
11. EIA Electronic Industries Alliance
12. EMI Electromagnetic Interference
13. FCC Federal Communications Commission
14. HVAC Heating, Ventilation, and Air Conditioning
15. IEEE Institute of Electrical and Electronics Engineers
16. ITNO Information Technology Network Operations
17. ISO International Organization for Standardization
18. LAN local Area Network
19. Mb/s Megabits Per Second
20. MC Main Cross-connect AKA Main Distribution Frame (MDF)
21. MDF Main Distribution Frame AKA Main Cross-connect (MC)
22. NEMA National Electrical Manufacturers Association
23. NESCO National Electrical Safety Code
24. NFPA National Fire Protection Association
25. OFOI Owner Furnished Owner Installed
26. RCDD Registered Communications Distribution Designer
27. RFP Request for Proposal
28. RFO Request for Offer
29. SCS Structured Cabling System
30. TBB Telecommunications Bonding Backbone
31. TR Telecommunications Room AKA Intermediate Distribution Frame (IDF)

32. TGB Telecommunications Grounding Busbar
33. TMGB Telecommunications Main Grounding Busbar
34. TIA Telecommunications Industry Association
35. UL Underwriters Laboratories
36. UTP Unshielded Twisted-pair
37. WA Work Area
38. WAP Wireless Access Points

1.5 ADMINISTRATIVE REQUIREMENTS

A. Coordination

1. The Communications Cabling Contractor, here after referred to as “Contractor”, shall provide all materials, components, tools and labor necessary for the complete installation of all communications work required in the contract documents and specified herein.
2. The Electrical Contractor, here after referred to as “Electrical Contractor”, shall provide materials, components, tools and labor to complete a communications cabling pathway, electrical power distribution and communications building grounding system as set forth in the Structured Cabling System specifications and electrical specifications and T and E drawings.
3. Work furnished and installed by the Contractor as specified in Division 27 and as shown in E and T drawings includes:
   a. The overhead cable runway system (basket tray) within the new MDF;
   b. Identification for Communications Systems;
   c. Communications Equipment Room Fittings;
   d. Communications Backbone Cabling;
   e. Communications Horizontal Cabling;
   f. Patch Cords, Station Cords, and Cross-Connect Wire;
   g. Coordination with OFOI Communications Services;
   h. Coordination with OFOI Data Communications Equipment;
   i. Coordination with OFOI Voice Communications Equipment;
4. Work under this Division not in contract (NIC) that will be Owner Furnished/Owner Installed (OFOI) includes:
   a. Communications services;
   b. Voice communications equipment;
   c. Phone cords at the work area;
5. Work furnished and installed by the Electrical Contractor as specified in Division 27 and as shown in E and T drawings includes:
   a. The conduits and back boxes for the work area telecommunications outlets.
   b. Installation of the TMGB in the new MDF;
   c. Installation of the TBB from the new MDF to the new IDF’s;
   d. Installation of the Bonding Conductor for Telecommunications (BCT) that bonds the TMGB to the electrical power ground compliant with ANSI J STD-607 C Standards;
   e. Bonding conductors from all cable tray, sleeves and conduits;
   f. Electrical circuits in the telecom rooms.
6. Work furnished and installed by others.
   a. Telecommunications room(s) walls shall be covered, floor to ceiling, with rigidly fixed ¾” fire rated plywood, void free, and capable of supporting attached connecting hardware. Plywood should be covered with two coats of fire retardant paint per Section 27 05 53.
   b. Fire walls shall be marked for easy identification and painted with two coats of fire retardant paint.

1.6 WORK RESULTS - DESCRIPTION OF PROJECT *to be performed; examples below.)*

A. Administrative Services

1. Contractor is required to provide test results and as-built documentation/record drawings prior to job acceptance.

B. Underground Ducts and Raceways
   1. The Outside Plant cable pathway shall connect the Galveston County road and bridge office building to the redundant ISP facilities as well as the Shop IDF, Wash Rack IDF, Fuel and Air station IDF and the Maintenance building IDF. The Service entrance for communications shall be a minimum of (4) 4” conduits from the nearest easement to the MDF.
   2. No more than two 90° bends are allowed between pulling points when installing underground entrances. All bends must be long, sweeping bends with a radius no less than 10 times the internal diameter (ID) of the conduit.
   3. Communication conduits shall be the top tier utility within the duct bank with a minimum of 18” separation from high voltage cabling.
   4. Conduits shall have a pull cord having a metallic member (tone tape) with a minimum test rating of 200 lbs pulling strength in each conduit. Reference: Arnco DL WP12LC Tone Tape or equivalent. All pull cords shall be secured at each end to prevent accidental removal.
   5. Underground Ducts and Raceways described in Section 27 05 43.

C. Grounding and Bonding
   1. Provide and install a Telecommunications Grounding Busbar (TGB) in Intermediate Distribution Frames (IDF).
   2. Provide and install a Telecommunications Main Grounding Busbar (TMGB) in building’s Main Distribution Frame/MDF.
   3. Bonding conductors from the TMGB or TGB will be installed to all communications terminating to equipment cabinets, equipment racks, raceway, cable ladder rack, cable tray, sleeves and conduits. Bond all TGBs to the TMGB per Section 27 05 26.
   4. Bond TMGB to building ground per Section 27 05 26.
   5. Final design and specifications for the Grounding and Bonding system shall be coordinated with the Electrical Engineer of Record.
   6. Building entrance protection for copper cabling.
   7. Grounding and Bonding for Communications described in Section 27 05 26.

D. Pathways for Communications Systems
   1. The primary horizontal cable support system will be conduit to J-hooks. One-inch (1”) conduit servicing end users information outlets shall be "stubbed" to above the ceiling and routed to the nearest corridor/hallway telecommunications horizontal cable pathway leading to the MDF or IDF. Wall penetrations shall transition to properly fire-stopped sleeves, then back to cable tray.
   2. Outlets having one single cable require a single gang box that routes to the cable tray via minimum one-inch (1”) conduit with pull string.
   3. Outlets having two or more cables require a double gang box with a single gang reducer that routes to the cable tray via minimum one inch (1”) conduit with pull string.
   4. Conduit runs may not be longer than 100ft or contain more than two 90 degree bends between pulling points, pull boxes or reverse bends without the use of a properly sized junction box. Insulated throat compression fittings must be used for communications conduit runs, with termination points having plastic or grounding bushings installed.
   5. Riser sleeves in IDF must be properly installed with bushings and fire sealed. Initial sealing of the sleeve penetration is to be completed by the sleeve installer.
   7. All sleeves shall be reamed and grommets placed prior to cable installation to prevent cable damage.
   8. All telecommunications conduit shall be provided with a measured pull tape.
   9. Pathways for Communications described in Section 27 05 28.

E. Identification for Communications Systems
   1. All labeling will be compliant with TIA/EIA606-B - Administration Standard for Commercial Telecommunications Infrastructures as described in Section 27 05 53.
   2. All labeling will comply with Owner administrative labeling scheme of cabling and its numerical positions on the termination hardware. Ensure compliance with Owner's

preferred administrative labeling standards.

F. Communications Equipment Room Fittings
1. The communications service entrance point is located in the main office MDF. The new service entrance pathway will consist of two redundant routes consisting if two (2) 4" conduit(s) from the nearest ISP demarcation point to the main office MDF.
2. Space for new outside plant fiber cable and terminating hardware will be provided in the Main office MDF.
3. The new MDF will be located in the main office building of the facility with the IDFs in the Maintenance Shop, Warehouse, Fuel Air Station and Wash Rack 4) _4" sleeves/conduits between network facilities.
4. Contractor shall provide (2) each 19" floor mounted equipment racks in the main office MDF installed per T drawings. Equipment racks shall be properly bonded.
5. Communications Equipment Room Fittings described in 27 11 00.

G. Communications Backbone Cabling
1. Provide _(12)_ strand, 9/125 micron single-mode fiber from MDF to each IDF.
2. Provide _1_ pair of vertical/horizontal copper backbone cabling consisting of 25- pair unshielded twisted pair Category 3 copper cables from the Main cross-connect field in MDF to each IDF copper cross-connect field. Copper cable shall meet or exceed the mechanical and transmission performance specifications in ANSI/TIA/EIA-568-B.2 up to 16 MHz.
3. Copper cable shall be provided as required in NEC 2002; Listed Type CMR, CMP, MPR and/or MPP.
4. All copper backbone cables shall have a minimum 10ft service loop, and all fiber backbone cables shall have a minimum 20ft service loop.
5. Multi-mode outside plant fiber optic cable shall be provided for fire alarm connectivity only.
6. Communication Backbone Cabling requirements described in 27 13 00.

H. Communications Horizontal Cabling
1. All voice and data horizontal cables will consist of plenum rated, Category 6, 4 pair UTP copper cables terminated on 24 and 48 port RJ45 Category 6, 568A patch panels in the IDF's. The maximum horizontal distance from the workstation to the patch panel shall be 295 feet.
2. Communications Horizontal Cabling requirements described in 27 15 00.

I. Termination Hardware

1. All cable termination hardware shall be mounted in one of the Contractor provided and installed 19" racks – refer to T-drawings for rack locations and counts.
2. Fiber backbone cabling shall terminate in, fully populated, rack mounted Fiber Panels using ST connectors and adapters.
3. Horizontal cabling shall terminate on rack mounted Category 6 24 or 48 port patch panels in the MDF's/IDF's, and on RJ45 568A Category 6 inserts at the outlet.

J. Patch Cords, Station Cords, and X-Connect Wire
1. Contractor shall provide two (2) Category 6 patch cords per horizontal cable installed: 50% 5' length, 50% 15' length.
3. Contractor shall provide one (1) duplex fiber optic patch cords per fiber termination; patch cords shall be consistent with fiber and connector type. Lengths as required for neat and professional installation. Average length 10m. Coordinate with Owner prior to ordering.

K. Data Communications Equipment
1. Data communications equipment will be OFOI.

L. Voice Communications Equipment

1. Voice communications equipment will be OFOI.

M. Network Connectivity for Other Trades:
1. Audio/Visual – Provide network connectivity as required for A/V elements. Refer to AV drawings and specifications for details.
2. Electronic Safety and Security – Provide copper and fiber cabling and termination hardware as required facilitating voice and data network connectivity for IP cameras, Emergency Call Towers, Access Control Panels, etc. Refer to Security drawings and specifications for details.
3. Fire Alarm – Provide copper/ fiber connectivity as required for Fire Alarm Panels.
4. Building Management System – Provide network connectivity as required facilitating operation of BMS/DDC.
5. Elevator Equipment Room – Provide copper connectivity to elevator equipment room(s). Coordinate with elevator equipment provider.

N. Commissioning Administration
1. Contractor shall comply with General Commissioning Requirements of the technology infrastructure system.

O. Project Meetings
1. Contractor shall attend preconstruction meetings with Project Team.
2. Contractor shall provide representation on Project Team Meeting as specified in Division 1 and by the General Contractor as required.
3. Contractor will provide representation on the Commissioning Team as required for implementation of the Commissioning Plan.

P. Preconstruction Evaluation
1. Examination of buildings and site shall be the responsibility of the Contractor. Examine conditions for compliance with Communications design specifications. Validate Communications section is in accordance with related Contract Documents and the specified Owner's operational needs.

Q. Construction Documentation
1. Contractor shall coordinate requirements with general provisions specified in Division 1 - Construction Progress Documentation.
2. Contractor shall provide weekly progress report including synopsis of previous week's completed tasks, list of ongoing work, and updated schedule addressing milestones. Also include items for Owner coordination.
3. Contractor shall provide weekly report of inspection by project RCDD to confirm Contractor's work is compliant with industry and manufacturer standards.

1.7 PROPOSAL SUBMITTALS

A. Contractor Certification:
1. Contractor shall be a licensed Panduit Certified Integrator (PCI) Design and Installation Company and a Uniprise Certified Installer (UCI) capable of issuing a numbered registration certificate for the entire cable system. A copy of the PCI Company and UCI certificate or verification by Panduit and/or Uniprise records must accompany contractor bid, expired certificates and/or certificates issued under Panduit or Uniprise past certification programs will not be accepted. Proof of certification must be included in proposal.
2. Submit written proof that the contractor is certified by the manufacturer of the products and adheres to the engineering, installation and testing procedures and utilizes the authorized manufacturer components and distribution channels in provisioning this Project.
3. 100 percent of on-site personnel shall have either a Uniprise or Panduit Certification in effect through, the bidding process, installation, testing, documentation, and acceptance. Documentation of all on-site personnel shall be provided post recommendation of selected

contractor before final ITNO approval will be given.

4. 100 percent of on-site installation personnel shall have BISCI certification in effect through the bidding process, installation, testing, documentation and acceptance. Documentation of all on-site personnel shall be provided post recommendation of selected contractor before final ITNO approval will be given.
5. Contractor must have a minimum of one (1) Registered Communications Distribution Designer (RCDD) on staff, with Panduit approved Certification plus RCDD equivalent, submitted and approved by Panduit or Uniprise prior to project award. Submit a resume and copy of certifications for Contractor's RCDD.
6. The RCDD shall provide approval on the design, installation, and documentation of communications system along with ensuring all Panduit Integrity System or Uniprise Warranty documentation and requirements are met and submitted to Panduit or Uniprise upon completion of the project. Documentation of all on-site personnel shall be provided before final ITNO approval is granted.
7. Contractor shall have worked satisfactorily for a minimum of five (5) years on systems of this type and size.
8. Design and Installation Certificates: Signed by local cable manufacturer's representative certifying that design is acceptable with cable manufacturer's Design Engineer(s) and Contractor is authorized by manufacturer to install registered (warranty) cabling system.

B. A list of technical product education (training) completed by the Contractor's project personnel.
   1. All members of the installation team must be certified by the Manufacturer as having completed the necessary training to complete their part of the installation. Submit resumes of the entire team and completed training courses and copies of BICSI Installer as well as Uniprise or Panduit training course certificates.
   2. Submit cable tester manufacturer or a third party certification for copper and fiber cable test technicians.

C. Warranty
   1. Unless otherwise specified, unconditionally guarantee in writing the materials, equipment, and workmanship for a period of not less than fifteen (15) years from date of acceptance by Panduit or 20 years for Uniprise.

D. Price Quotation Information -
   1. Itemized Unit Pricing for Labor and Material;
   2. Itemized Add/Deduct Unit Pricing for Labor and Material for Pre-Cutover (200' average length) FOUR (4) CAT 6 Drops;
   3. Itemized Add/Deduct Unit Pricing for Labor and Material for Post-Cutover (200' average length) FOUR (4) CAT 6 Drops.

1.8 SUBMITTALS FOR PROJECT RECORD

A. Follow Division 1 and this Section.
   1. Drawings: As-built documentation must be submitted five (5) business days prior to obtaining approval for cutover to any portion of the new cable plant system. Furnish for review and comments, 4 complete sets of E size (30 by 42) and 4 complete sets of C size as-built drawings along with 4 CDs containing all electronic AutoCAD 2000 or newer (DWG) files.
   2. Submit project record drawings at conclusion of the project to include:
      a. Final approved Shop Drawings
      b. Plan drawings indicating location and identification of work area outlets, nodes, plan and elevation of telecommunication rooms, cable pathway details, and backbone cable type and locations and cable ID numbers.
   3. 4 sets of cable inventory data must be submitted for all copper and fiber, termination hardware (prior to cutover to new cable plant if applicable.) Submit data in binders and electronically on CDs in "Microsoft Excel" format, listing products furnished, including:
      a. Manufacturer's name and part numbers.

b. Cable numbers utilizing the Owner's cable numbering standard.
c. Telecommunication and Equipment Room termination detail sheets
d. Location and riser assignments.
e. Cross-connect schedules including entrance point, main cross-connects, intermediate and horizontal cross-connects.
f. Labeling and administration documentation
g. Warranty documents for equipment
h. Copper certification test result printouts and diskettes
i. Optical fiber power meter/light source test results.

4. Manufacturer Certificates: Within 10 days of completion of the project, Contractor shall deliver letter signed by local Structured Cabling Components representatives and Contractor's RCDD stating that installed cabling system complies with all requirements specified in manufacturer's installation guidelines and that there were no accidents, improper installation, mishandling, misuse, damage while in transit, unauthorized alteration, unauthorized repair, failure to follow instructions, or misuse with the structured cabling system that could adversely impact warranty.
5. Test Reports: 4 sets of hard copies with 4 copies on CD in compliance with related Test Result Documentation.
6. Submitted test results and other submittals that are non-compliant will be reviewed and returned to the Contractor with comments.
7. Re-submitted test results and other submittals that are non-compliant will be reviewed and returned to the Contractor with comments.
8. Subsequent reviews of test results and other submittals will be performed jointly by the Contractor and the Communications Consultant and Contractor will pay Communications Consultant's published hourly rate during third review and thereafter.
9. Manufacturer's warranty to the Owner. This shall include, but is not limited to: Owner's name and project name and address. (Within three weeks of substantial completion).
10. Within 10 days of completion of the project, Contractor shall deliver letter signed by local SCS Manufacturers representative and Contractor's RCDD stating that installed cabling system complies with all requirements specified in installation guidelines and that there were no accidents, improper installation, mishandling, misuse, damage while in transit, unauthorized alteration, unauthorized repair, failure to follow instructions, or misuse with the structured cabling system that could adversely impact warranty.
11. Within 21 days of completion of a project the communications contractor and/or the manufacturer's local representative will provide owner The Structured Cabling Performance Warranty signed by the manufacturer. The warranty shall list the owner and name of the Facility including location as the holder of the warranty.

1.9 EQUIPMENT RELOCATION AND SYSTEM STARTUP

A. Upon notice of construction completion, the selected Contractor will be responsible for system startup services for the new telecommunication room. The Contractor shall be responsible for ensuring the new equipment rooms, cabinets, floors and walls are clean and ready for equipment installation. On behalf of the Owner, the Contractor shall be responsible for coordinating with the GC and other trades to keep the MDF and IDFs clean and dust free at all times.

B. It shall be the responsibility of the Contractor to develop and implement a full migration project schedule detailing the responsibilities of assigned personnel, along with contingency plans, and submit it to the Owner, or their designated representative, for approval.

C. During the transition period, Contractor shall have the necessary supervisory, technical, and other personnel available throughout technology relocations and cutover of the telephone, networking, and video systems. This is to ensure that technicians are on site to observe the operation and maintenance of the equipment, and to resolve any cabling related issues during system start-up.

D. Contractor shall ensure all amenities are present prior to equipment relocation. Contractor shall

immediately contact the Owner, or their designated representative, if a required service such as HVAC, electrical, UPS, etc., are not present.

E. Contractor shall accomplish a smooth and successful transition of operations and services to the new telecommunication room. The transition includes the coordination, migration, testing, and problem resolution with the system vendors.

1.10 SEQUENCING AND SCHEDULING

A. An initial planning meeting will be held with the successful bidder to clarify all requirements (systems, services, distribution methods, etc.), identify responsibilities, and schedule the events that will transpire during the implementation of the project. Within two (2) weeks of the initial meeting, the Contractor shall provide a written report and project schedule to clearly document the events and responsibilities associated with the project.

B. Contractor shall be responsible for the development and implementation of a complete project schedule detailing the responsibilities of assigned personnel and submit it to the GC and Owner for approval.

1.11 QUALITY ASSURANCE - CONTRACTOR QUALIFICATIONS

A. Follow Division 1 and this Section.

B. Voice/Data
1. The installation company shall have a full-time RCDD on staff during all phases of the installation including testing and documentation. RCDD documentation shall be included in all responses to RFP/RFO.
2. The Installer shall have either Uniprise or Panduit Certification in effect throughout installation, testing, documentation and acceptance.
3. One hundred percent (100%) percent of on-site personnel shall be CommScope certified. The contractor's project manager or lead technician shall be BICSI certified to facilitate on-site installation practices and to provide inspections of on-going work.
4. Untrained, undocumented, or otherwise unqualified personnel are not allowed to perform any portion of the communications infrastructure installation.
5. All personnel must be permanent employees of the telecommunications contractor, or approved sub-contractors.

PART 2 - PRODUCTS

2.1 PRODUCT SCHEDULE

A. Refer to Division 27 sections for approved product and schedules.
1. 27 05 26 Bonding and Grounding For Communications System
2. 27 05 28 Pathways For Communications Systems
3. 27 05 43 Underground Duct And Raceways
4. 27 05 53 Identification For Communications Systems
5. 27 11 00 Communications Equipment Room Fittings
6. 27 13 00 Communications Backbone Cabling
7. 27 15 00 Communications Horizontal Cabling
8. 27 16 19 Patch Cords, Station Cords And Cross-Contact Wire
9. 27 20 00 Data Communications Equipment
10. 27 30 00 Voice Communications Equipment

2.2 WARRANTY

A. A 20-year CommScope Extended Product Warranty and System Assurance Warranty for this wiring system shall be provided.

B. The warranty covers all CommScope cables installed, tested and registered in a structured cabling system for a period of 20 years. A structured cabling system is defined as a cabling

infrastructure, designed and installed to current ANSI/TIA/EIA-568-B series standards.

C. The Extended Product Warranty shall ensure against product defects, that all approved cabling components exceed the specifications of ANSI/TIA/EIA 568B and ISO/IEC IS 11801, exceed the attenuation and NEXT requirements of ANSI/TIA/EIA 568B and ISO/IEC IS 11801 for cabling links/channels, that the installation will exceed the loss and bandwidth requirements of ANSI/TIA/EIA 568B and ISO/IEC IS 11801 for fiber links/channels, for a twenty year period. The warranty shall apply to all passive SCS components.

D. Unless otherwise specified, unconditionally guarantee in writing the materials, equipment, and workmanship for a period of not less than twenty (20) years from date of acceptance by Information Technology Network Operations.

E. Warrant installation against all product defects, and that all approved cabling components meet or exceed the requirements of TIA/EIA-568B and ISO/IEC 11801 for a period of 20 years.

F. The Extended Product Warranty and the System Assurance shall cover the replacement or repair of defective products and labor for the replacement or repair of such defective products.

G. Within 10 days of completion of the project, Contractor shall deliver letter signed by local SCS Manufacturers representative and Contractor's RCDD stating that installed cabling system complies with all requirements specified in installation guidelines and that there were no accidents, improper installation, mishandling, misuse, damage while in transit, unauthorized alteration, unauthorized repair, failure to follow instructions, or misuse with the structured cabling system that could adversely impact warranty.

H. Within 21 days of completion of a project the communications contractor and/or the manufacturer's local representative will provide owner The Structured Cabling Performance Warranty signed by the manufacturer. The warranty shall list the owner, name of the facility including location as the holder of the warranty.

I. The Owner shall not be responsible for any aspect of ensuring the warranty is issued or updated. It shall be the Contractor's responsibility in conjunction with the Manufacturer.

J. During the warranty period, Owner may engage any (manufacturer approved) communication contractor to perform future moves, adds and changes to the system. Owner approved contractors shall be responsible for updating any required documentation. Owner shall not be responsible for any aspect of updating and maintaining the warranty.

K. The Labor, Material and Performance Warranty shall cover the testing and replacement of all structured cabling components. The structured cabling system shall be a complete certified system. The system and all components shall be performance matched and guaranteed by the manufacturer.

L. Person / Entity Covered
   1. This warranty is for the sole benefit of Owner and any successor in interest to the site in which such Registered SCS was originally installed.
   2. All communications work and materials not included in the SCS components shall be warranted by the contractor that performed the work for a minimum of three years from the date of substantial completion.

2.3 DELIVERY, STORAGE, AND HANDLING

A. Delivery Requirements: Follow Division 1 Requirements.

B. Packing, Shipping, Handling, and Unloading
   1. Protect equipment during transit, storage, and handling to prevent damage, theft, soiling and misalignment.
   2. Coordinate with ITNO for temporary secure storage of equipment and materials during project timeframes.
   3. Do not store equipment where conditions fall outside manufacturer’s recommendations for

environmental conditions.

4. Do not install damaged equipment; remove from site and replace damaged equipment with new equipment.

C. Acceptance at Site

1. All risk of damage or loss will remain with the Contractor until project completion and acceptance of the installation by the Project Manager. Upon acceptance, risk of loss will pass to the Owner. Prior to that time, the Contractor shall be solely responsible for security of all Contractor provided project materials.

D. Storage and Protection

1. All materials and equipment delivered and placed in storage shall be stored with protection from the weather, humidity, and temperature variation, dirt, and dust, or other contaminants.
2. Material will be properly packaged in original factory-fabricated type containers and protected from damaging fumes, construction debris, and traffic until installation or job completion.
3. Any flammable materials or hazardous materials shall be kept and/or stored in suitable places approved by the General Contractor and outside the buildings at all times.

2.4 PRODUCT QUALITY ASSURANCE

A. All materials and equipment provided shall be the standard Commercial-Off-The-Shelf (COTS) products of a manufacturer engaged in the manufactures of such products. All materials shall be typical commercial designs that comply with the requirements specified. All materials and equipment shall be readily available through manufacturers and/or distributors. All equipment shall be supplied complete with any optional items required for proper installation.

B. In the event of a breach of the representations and warranties contained herein, the Contractor, at their own expense, shall take all measures necessary to correct and make the cabling system work in compliance with the applicable manufacturer written technical recommendations and standards.

PART 3 - EXECUTION

3.1 SITE CONDITIONS

A. Existing Site Conditions

1. Cable pathways and runs to individual outlets are not shown in their entirety but shall be provided as if shown in their entirety. The Contractor shall coordinate with other trades to determine exact routing.

B. Environmental Limitations

1. Due to the critical nature of the environment, the Contractor shall use extra effort to provide a clean work environment, free from trash/rubbish accumulated during and after cabling installation. Contractor shall remove all rubbish from job site daily at his or her own expense.

C. Use of Site

1. Proceed with work without interfering with ordinary use of streets, aisles, passages, exits, and operations of the Galveston County Road and Bridge Facility including Information Technology Network Operations.
2. Contractors will adhere to the Galveston County Road and Bridge Facility Contractor Badge program and will wear assigned contractor's badge on person in a clearly visible location following the Contractor Badge program standards as administered and provided by Facilities Planning & Construction.
3. Access to buildings where work is to be performed shall be directed by Information Technology Network Operations.
4. Contractors shall provide proper safeguards with personnel or appropriate safety

barricades when pulling cables in any Galveston County Road and Bridge Facility or related off-site areas.

D. Continuity of Services
   1. Previous arrangements must be made with a Galveston County representative to avoid interference with, or interruption of, existing building services. The work shall be arranged to minimize down time.

3.2 EXAMINATION

A. Examination of buildings and site shall be the responsibility of the Contractor. Examine conditions for compliance with requirements of other sections in which related work is specified and determine if conditions affecting performance of the work of this Section are satisfactory. Do not proceed with work of this Section until unsatisfactory conditions have been corrected in an acceptable manner.

B. Verify liquid-carrying pipes are not installed in or above voice and data system equipment rooms.

C. Verify fire-rated backboards are properly installed and painted following Section 06105. Notify the Project Manager immediately and prior to installation in the event that the backboards are not installed or painted properly.

D. Verify conduit, raceways, and boxes are properly installed.

E. Prior to starting the installation, the assigned installation supervisor shall participate in a walk-through of the project site with the Project Manager to review the installation documentation, verify that all construction necessary for the installation has been completed, and verify all installation methods and cable routes.

F. The Contractor shall provide a complete cabling infrastructure according to the written specifications and drawings. If the scope of work to be performed by the Contractor changes, it shall be in writing. Contractor shall respond to these changes with a complete material list, including pricing, labor, and taxes in writing per Division 1 requirements. Contractor shall not proceed with additional scope of work without signed approval by the General Contractor.

3.3 PREPARATION

A. Protection of Surroundings
   1. Repair: Patching and repair of facilities, finishes, and equipment. Any damage to building or site caused by Contractor, including grass, paving, curbs etc., shall be restored at Contractor's expense to match condition prior to damage. If necessary and requested by the General Contractor, Contractor shall provide professional services to clean or repair scratched/soiled finishes at their own expense.
   2. Contractor shall keep all foods and liquids (water, drinks, etc.) in designated break areas.
   3. The Contractor shall obtain the Architect's and Engineer's written permission via the General Contractor before proceeding with any work necessitating cutting into or through any part of building structures such as girders, beams, concrete or tile floors, partition and/or ceilings.
   4. If it becomes necessary to cut through any wall, floor, or ceiling to install any work under this Section of the Contract or to repair any defects that may appear up to the expiration of the guarantee period, such cutting shall be done by the Contractor under the supervision of the General Contractor.
   5. Patching of all openings cut by the Contractor, or repairing of any damage to the work of other trades caused by cutting or by the failure of any part of the work installed under this Contract, shall be performed by the appropriate trade but shall be paid for by the Contractor.
   6. 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 approved by the Architect/Engineer.

7. 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.
8. Refer to Division 1 for additional information.

3.4 DEMOLITION/REMOVAL

A. Unless indicated otherwise, all items that must be removed due to interference with work of this contract remain the property of the Owner, and are to be salvaged at the Owner's discretion. Any material to be salvaged, other than Contractor's waste material, must be approved in writing by the General Contractor.

3.5 FIRESTOPPING

A. The Contractor is required to properly fire-stop any penetrations through fire barriers utilized for the placement of telecom cabling. Provide fire resistant intumescent materials to restore fire ratings to wall, floor, or ceiling penetrations according to local and national codes.

B. Verify the hourly rating of the barrier.

C. Select the UL Listing to match or exceed the barrier.

D. Adhere to cable loads and fill procedure in the Listing.

E. Seek pre-approval from the Authority Having Jurisdiction (Inspector).

F. When installing the System, be sure not to exceed the listing limitations.

G. After installation, place information labels and take digital photographs of both sides of each fire stopped penetration in the System for future reference.

H. 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.

I. Provide fire resistant materials to restore fire ratings to all wall, floor, or ceiling penetrations used in the distribution and installation for communications cabling system. Coordinate fire stopping procedures and materials with General Contractor and Div.7.

J. Solutions and shop drawings/submittals for fire stop materials and systems shall be presented to the General Contractor for written approval of materials prior to purchase and installation.

K. Materials shall be installed per manufacturer instructions, be UL listed for intended use, and meet NEC codes for fire stopping measures.

L. The material chosen shall be distinctively colored to be clearly distinguishable from other materials, adhere to itself, and remain resilient and pliable to allow for the removal and/or addition of communication cables without the necessity of drilling holes in the material.

M. The fire stopping material shall maintain/establish the fire rated integrity of the wall/barrier that has been penetrated.

N. Contractor shall coordinate with electrical contractor and ensure Communications Pathway firestopping is properly identified and labeled. Contractor shall laminate and permanently affix to each side of a fire wall/floor penetration, the following information:
   1. Installing Contractor's name, address and phone number.
   2. Alpha-numeric unique identifier (floor/penetration - A1)
   3. Name of manufacturer of fire stop system.
   4. Part & model numbers of system and all components.
   5. Phone numbers of manufacturer's corporate headquarters in U.S. and local distributor's name and phone number.

3.6 CONSTRUCTION WASTE MANAGEMENT

A. Contractor shall remove all excess material and debris from the site upon completion of work each day and in a manner approved by the General Contractor's Project Manager. See Division 1.

3.7 LABELING

A. Confirm administrative labeling scheme of cabling and its numerical positions on the termination hardware. Ensure compliance with Owner's preferred administrative labeling standards.

3.8 CLOSEOUT ACTIVITIES

A. Acceptance shall be subject to substantial completion of all work, successful post-installation testing which yields 100% PASS rating, and receipt of full documentation as described herein.
   1. All Proposal Submittals and Project Record Submittals.
   2. Training to Owner's representative on methods to add and remove fire stop barriers, add and remove isolation conduit seals and, when necessary, add and remove IP 67 rated outlets.
   3. Maintenance manuals specified in Div. 1 to GC and Owner regarding structured cabling system, firestopping and conduit sealing methods and manufacturer's recommended maintenance instructions.
   4. Contractor shall complete all punch list items within five (5) days of notification by GC.
   5. Contractor shall wipe down all equipment, racks, cabinets, and sweep and mop ER/TR floors prior to Substantial Completion. Project will not be considered complete until cleaning has been done.
   6. Contractor shall complete Closeout Checklist listing status of all submittals, maintenance manuals, Owner training, and punch list items and deliver per Division 1.

END OF SECTION

SECTION 27 05 26
GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Work covered by this Section consists of furnishing labor, equipment, supplies, materials, and testing unless otherwise specified, and in performing the following operations recognized as necessary for the installation, termination, and labeling of grounding and bonding infrastructure as described on the Drawings and/or required by these specifications.

1.2 RELATED SECTIONS

A. Refer to Section 27 05 00 for detailed information on scope of work.

B. Refer to Section 27 05 53 for all labeling requirements.

1.3 DEFINITIONS

A. MDF-Main Distribution Facility: The main room, which typically contains the PBX, and main Data Communications equipment.

B. IDF-Intermediate Distribution Facility: Any additional room containing switches, hubs, patch panels and cross-connects away from a central location to serve areas out of distance from the MDF.

C. TO - Telecommunications Outlet: Point of connectivity for voice, data or video on the wall or in the floor. Refer to Telecommunications Drawings and Symbol sheet(s) for quantities and types of media at each outlet.

D. TMGB - Telecommunications Main Grounding Busbar: The dedicated extension of the building grounding electrode system for the telecommunications infrastructure.

E. TGB - Telecommunications Grounding Busbar: The grounding connection point for telecommunications systems and equipment in the area served by an ER.

F. TBB - Telecommunications Bonding Backbone: A bonding conductor that provides direct connection between the TGB's and TMGB.

1.4 SECTION INCLUDES

A. Grounding electrodes and conductors.

B. Equipment grounding conductors.

C. Bonding.

D. Communication system grounding.

E. Electrical equipment and raceway grounding and bonding.

F. Control equipment grounding.

1.5 REFERENCES

A. Follow Section 01423

B. American Society for Testing and Materials (ASTM):
   1. B 3 Soft or Annealed Copper Wires
   2. B 8 Concentric-Lay-Stranded Copper Conductors, Hard, Medium Hard, Soft
   3. B 33 Tinned Soft or Annealed Copper Wire for Electrical Purposes

C. Institute of Electrical and Electronics Engineers (IEEE):

1. 142-82 Recommended Practice for Grounding of Industrial and Commercial Power Systems
2. 1100 Recommended Practice for Powering and Grounding Sensitive Electronic Equipment in Industrial and Commercial Power Systems.

D. Underwriters' Laboratories (UL):
1. 83 Thermoplastic Insulated Wire and Cables
2. 96 Lightning Protection Components
3. 96A System Installation
4. 467 Grounding and Bonding Equipment

E. National Fire Protection Association (NFPA):
1. 780 Lightning Protection Code
2. 70 National Electrical Code (NEC)
   a. NEC Article No. 250 - Grounding

F. American National Standards Institute/Telecommunications Industry Association/Electronic Industries Alliance (ANSI/TIA/EIA):
1. J-STD-607-C Commercial Building Grounding and Bonding Requirements.
2. Telcordia – Network Equipment Building Systems (NEBS) GR-1275.

G. Building Industry Consulting Services International (BICSI):
1. Telecommunications Distribution Methods Manual
2. Customer Owned Outside Plant Design Manual

H. Local, county, state and federal regulations and codes in effect as of date of “notice to proceed” shall be complied with.

PART 2 - PRODUCTS

2.1 GROUNDING BUSBARS

A. Telecommunications Main Grounding Busbar (TMGB)
1. Chatsworth #10622-012 ground busbar with Chatsworth #10622-000 busbar insulators or equivalent.

B. Telecommunications Grounding Busbar (TGB)
1. Chatsworth #10622-012 ground busbar with Chatsworth #10622-000 busbar insulators or equivalent.

2.2 GROUNDING JOINTS AND SPLICES

A. Grounding conductor joints/splices shall be mechanical type, copper alloy, with a minimum of two bolts and a separate section for each conductor equal to Burndy “QPX”, OZ/Gedney “XTP” or “PMX” or Penn-Union “VX” or copper compression type with two (2) indents equal to Burndy, T&B or Blackburn.

B. Grounding conductor terminations (lugs) shall be single barrel, mechanical screw type, copper alloy with machined contact surfaces equal to OZ type “SL”, T&B, or Burndy or copper compression type with two (2) indents equal to Burndy, T&B or Blackburn.

2.3 BONDING CONDUCTORS

A. Cable Tray Bonding Conductor
1. Green #8 AWG insulated bonding jumper (12” max) with appropriate lugs or manufactured braided copper grounding jumper equal to B-Line #CAM-GJ, T&B #BD12, OZ/Gedney type “FB” or Mono-Systems.

B. Equipment Frame Bonding Conductor
1. Panduit #TRGK672 Telecommunications Rack Grounding Kit.

C. Bonding Conductor (BC)
1. Green insulated copper bonding conductor, size as required by NEC.
2. The BC shall be, as a minimum, the same size as the TBB.

D. Telecommunications Bonding Backbone (TBB)
   1. Green insulated copper conductor, minimum size of No. 6 AWG. The TBB shall be sized at 2 kcmil per linear foot of conductor length up to a maximum size of 3/0 AWG. Insulation shall meet fire ratings of its pathway.
      a. Table 1
         1) Sizing of the TBB
         2) TBB length (ft) TBB Size (AWG)
            (a) Less than 13 6
            (b) 14-20 4
            (c) 21-26 3
            (d) 27-33 2
            (e) 34-41 1
            (f) 42-52 1/0
            (g) 53-66 2/0
      b. Greater than 66 3/0

PART 3 - EXECUTION

3.1 TELECOMMUNICATIONS INSTALLATION

A. Installation of the TMGB
   1. Install the TMGB at the bottom of plywood backboard near the outside plant entrance conduits in the “MDF”.
   2. TMGB shall be installed so that the BC for telecommunications is as short and straight as possible.
   3. Conductor shall be installed in continuous 3/4” conduit.

B. Installation of the TGB
   1. Install the TGB at the bottom of plywood backboard near the copper riser terminations in each “IDF”.
   2. TGB shall be installed so that the TBB for telecommunications is as short and straight as possible.

C. Installation of the TBB
   1. Install Green insulated copper grounding conductor (refer to 2.03.D for conductor size) from the TMGB to each TGB.

D. Installation of Grounding Conductor Joints/Splices
   1. Install mechanical type, copper alloy, with a minimum of two bolts and a separate section for each conductor or copper compression type with two (2) indents.
   2. Install manufactured insulating cover or heavy tape insulation over joints/splices.

E. Grounding of Cable Tray
   1. Install Green #8 AWG bonding jumper (12” max) with appropriate lugs at each cable tray joint or install manufactured braided copper grounding jumper equal to B-Line #CAM-GJ, T&B #BD12, OZ/Gedney type “FB” or Mono-Systems.
   2. Install Green #6 AWG grounding conductor with appropriate lugs from side of cable tray down to TMGB or TGB. Drill and tap side of cable tray (for appropriate size bolt, ¼” x 20 min.), making sure that bolt does not extend into wire management part of tray.

F. Grounding of Equipment Frame
   1. Install Panduit or equivalent Telecommunications Rack Grounding Kit from equipment frame to grounded cable tray, TMGB, or TGB.

END OF SECTION

SECTION 27 05 28
PATHWAYS FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Interior communications pathways and supports.

B. Outlet and conduit runs.

C. Risers in ER/TR(s).

D. Grounding and bonding of pathways.

E. Pathway fire stopping requirements.

1.2 RELATED SECTIONS

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

B. Related Division 27 Sections include:
   1. 27 05 00 Common Work Results for Communications
   2. 27 05 53 Identification for Communications Systems
   3. 27 13 00 Communications Backbone Cabling
   4. 27 15 00 Communications Horizontal Cabling

1.3 SUMMARY

A. This Section specifies the requirements for the Pathways for Communications Systems for the Galveston County Road and Bridge Facility.

B. Communication Pathways are defined to include, but are not limited to innerduct, conduit, pull boxes, sleeves, cable trays, supports, accessories, associated hardware and fire stopping materials.

C. Final design and specifications for conduits shall be made by the Electrical Engineer of Record.

D. Work furnished and installed by Electrical Contractor as specified in this Section and as shown in E and T drawings includes:
   1. The conduits and back boxes for the work area telecommunications outlets.
   2. The floor poke through hardware.
   3. Fire stopping of cable tray and conduit cable pathway

E. Work furnished and installed by the Cable Contractor as specified in this section and as shown in E and T drawings includes:
   1. The overhead cable runway system (Basket Tray) within the new MDF.
   2. Bonding and grounding of overhead cable runway system (Basket Tray), racks and cabinets within the MDF/IDF.

F. The primary horizontal cable support system will be J-hooks, installed as shown in T drawings. Basket tray will be properly grounded. Wall penetrations shall transition to properly fire stopped 1”- 4” sleeves, then back to cable tray.

H. Outlets require a double gang box with a single gang reducer that stubs up into nearest accessible ceiling via one (1) 1” conduit with pull string.

I. Conduit runs may not be longer than 100ft or have more than two 90-degree bends without the use of a properly sized junction box. Insulated throat compression fittings must be used for communications conduit runs, with termination points having plastic or grounding bushings installed.

J. Minimum radii for conduit bends shall be as follows:
   1. Internal diameter of less than two (2) inches is 6 times the internal diameter.
   2. Internal diameter of more than two (2) inches is 10 times the internal diameter.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

A. Pathways:
   1. J-Hooks: Panduit
      a. J-Pro

B. Cable Tray: Cablofil
   1. 12” x 2” – CF54 /300 EZ
   2. 12” X 4” – CF105 / 300 EZ

2.3 CABLE HOOK SYSTEMS

A. J-hooks shall be installed 4ft to 5ft apart. Uniform spacing should be avoided to minimize problems with signal degradation.

B. J-hooks shall be supported from decking or building structure using methods approved by the manufacturer.

C. Cable count shall not exceed manufacturer’s recommended maximum. Add separate parallel J-hook pathway when cable count requires it.

2.4 CONDUITS AND FITTINGS

A. For each communication outlet indicated, provide a complete assembly of conduit, tubing or duct with fittings including, but not necessarily limited to, connectors, nipples, couplings, locknuts, bushings, expansion fittings, other components and accessories as needed to form a complete system of the same type indicated.

B. See SECTION 26 05 33 - RACEWAYS, CONDUITS AND BOXES

C. Minimum conduit size for Telecommunications Outlets shall be 1 (one) inch.

2.5 WALL AND CEILING OUTLET BOXES

A. All wall outlets shall be mounted in a minimum four 4 11/16” X 4 11/16” X 2 ½” deep double gang outlet box with a single gang mud-ring.

B. Outlet box accessories as required for each installation, including mounting brackets, wallboard hangers, extension rings, fixture studs, cable clamps and metal straps for supporting outlet boxes, compatible with outlet boxes being used and meeting requirements of individual situations.

2.6 PULL / JUNCTION BOXES

A. Pull boxes used with telecommunications conduits in interior locations shall be rated NEMA- 1. Pull boxes used in damp or wet locations such as plumbing chases or out of doors shall be rated NEMA-3R. Pull boxes shall be installed in conduits run at an interval no greater than every 100 feet. A pull box shall be installed in conduit runs whenever there are two 90°sweeps, or a total of 180°of sweeps, in a conduit run. A pull box may not be used to change the direction of a conduit run. Any deviations from these criteria must have prior approval from UH Information Technology.

2.7 PLENUM RATED FIBER OPTIC INNERDUCT

A. All fiber shall be installed in 1 ¼” corrugated, non-metallic plenum rated innerduct when not installed in conduit or in utility tunnel tray.

1. Innerduct shall be UL Listed with Flame Propagation compliant with UL 2024.
2. Only manufacturer's fittings, transition adapters, terminators and fixed bends shall be used.

B. Products
1. White or orange, plenum rated, UL Listed, flexible optical fiber/communication raceway.
2. Recognized per NEC Articles, 770 and 800 for plenum areas for optical fiber and telecommunications cables.
3. Provide all fittings to form a complete integrated raceway system.

C. Fabrication
1. Footage shall be sequentially marked.

2.8 CABLE TRAY SECTIONS AND COMPONENTS

A. General: Except as otherwise indicated, provide metal cable trays, of types, classes and sizes indicated; with splice plates, bolts, nuts and washers for connecting units. Construct units with rounded edges and smooth surfaces; in compliance with applicable standards; and with the following additional construction features.

E. All fittings must have a minimum radius of 24 inches.

F. Splice plates shall be the bolted type made as indicated below for each tray type. The resistance of fixed splice connections between adjacent sections of tray shall not exceed .00033 ohms. Splice plate construction shall be such that a splice may be located anywhere within the support span without diminishing rated loading capacity of the cable tray.

G Cable Tray Supports: Shall be placed so that the support spans do not exceed maximum span indicated on drawings. Supports shall be constructed from 12-gauge steel formed shape channel members 1-5/8 inch by 1-5/8 inch with necessary hardware such as Trapeze Support Kits (9G-55XX-22SH) as manufactured by Cooper B-Line, Inc. [or engineer approved equal]. Cable trays installed adjacent to walls shall be supported on wall mounted brackets such as B409 as manufactured by Cooper B-Line, Inc. [or engineer approved equal].

H. Trapeze hangers shall be supported by 1/2-inch (minimum) diameter rods.

J. Accessories - special accessories shall be furnished as required to protect, support, and install a cable tray system. Accessories shall consist of but are not limited to; section splice plates, expansion plates, blind-end plates, specially designed ladder dropouts, barriers, all-thread protection etc.

PART 3 - EXECUTION

3.1 SUMMARY

A. Final design and specifications for the Communications Systems conduits shall be made by the Electrical Engineer and Architect of record.

B. All communication pathways shall be sized in accordance with the requirements of BICSI and the NEC where conduit, pull boxes, cable tray and other raceway sizes are not specifically shown on contract drawings. No conduit shall be less than 1".

C. Conduits entering the Telecommunications Room shall be located allowing for the most flexibility in the routing and racking of cables.

D. Conduits between Building Telecommunication Rooms shall be four (4) inches.

E. Conduits or conduit sleeves entering through the floor of the Telecommunications Room shall terminate two (2) inches above the finished floor. The outer diameter of the conduit shall be located within four (4) inches of room walls.

F. All metallic telecommunications conduits entering the Telecommunications Room, Equipment

Room, or Entrance Facility shall be bonded together, and bonded to the Telecommunications Main Grounding Busbar with a #6 AWG ground cable.

G. Conduits shall be installed in the most direct route possible from the Telecommunications Room to the work area.

H. Conduits shall not be run next to hot water lines, steam pipes, or other utilities that may present a safety hazard or cause a degradation of system performance.

I. All in-use and spare conduits entering the Telecommunications Room, Equipment Room, or Entrance Facility shall be sealed to prevent the intrusion of water, gasses, and rodents throughout the construction project. Within five days of releasing the conduit for the installation of cable, the conduit installation contractor shall prove all conduits to be clean and dry.

J. All conduits and cables that penetrate fire rated walls or floors must be fire stopped.

K. Cables shall be neatly dressed along common paths with Velcro tie wraps with voice cables separated from data cables. Maximum number of cables per bundle shall not exceed manufacturer specifications.

L. Layout cable pathway runs in advance to determine space requirement along pathways, and to ensure non-interference from other trade installations.

M. Do not support communication pathway from, or lay on, ceiling suspension system or use electrical, plumbing, or other pipes for support. Communication pathway supports shall be permanently anchored to building structure or joist.

N. Provide attachment hardware and anchors designed for the structure to which attached, and that are suitably sized to carry the weight of the pathway and cables to be supported. Confirm with architect and/or construction manager on installation procedures for cable support system prior to implementation.

O. Conduits shall be reamed to eliminate sharp edges. Metallic conduit shall be terminated with an insulated bushing. Initial sealing of the sleeve penetration shall be completed by the sleeve installer. Refer to ANSI/TIA/EIA-606 and Section 27 05 53 for administration of the pathway system.

P. The inside of the cable tray or wireway shall be free of burrs, sharp edges or projections that can damage cable insulation. Abrasive supports (e.g., threaded rod) shall have the portion within the tray protected with a smooth, non-scratching covering so that sable can be pulled without physical damage. When a wireway passes through a partition or wall, it shall be an unbroken length. Installation of telecommunications cables shall not exceed the fill requirements. Openings in fire-rated walls, floors and ceilings shall be properly fire stopped. Barriers between power and telecommunications cables shall be installed per electrical code. Cable trays and wireways shall not be used as walkways or ladders unless specifically designed and installed for that purpose.

Q. Supports should be located where practicable so that connections between sections of the tray fall between the support point and the quarter section of the span. The support centers shall be in accordance with the load and span for the applicable class as specified in the electrical code. A support should be placed within 600 mm (2 ft) on each side of any connection to a fitting. Wireways shall be supported on 1500 mm (5 ft) centers unless designed for greater lengths.

R. A minimum of (12 in) access headroom shall be provided and maintained above a cable tray. Care shall be taken to ensure that other building components e.g., air conditioning ducts) do not restrict access to trays or wireways.

3.2 MINIMUM CLEARANCES

A. Communication Pathway minimum clearances from:

1. Minimum of 1 foot parallel, 3 inches crossover from power cables and conduits.
2. Minimum of 6 inches above ceiling tiles.
3. Minimum of 24 inches Hot Flues, Steam pipes, Hot water pipes and other hot surfaces.
4. Minimum of 3 feet separation from electrical panel boards.
5. Minimum of 5 inches from fluorescent fixtures.
6. Minimum of 6 feet separation from electrical motors and transformers.
7. Minimum of 2-inches from exposed all-thread rods.

3.3 FIRE STOPPING

A. Provide fire resistant materials to restore fire ratings to all wall, floor, or ceiling penetrations used in the distribution and installation for communications cabling system. Coordinate fire stopping procedures and materials with General Contractor and Electrical Contractor.

B. Solutions and shop drawings/submittals for fire stop materials and systems shall be presented to the General Contractor for written approval of materials prior to purchase and installation.

C. Materials shall be installed per manufacturer instructions, be UL listed for intended use, and meet NEC codes for fire stopping measures.

D. The material chosen shall be distinctively colored to be clearly distinguishable from other materials, adhere to itself, and remain resilient and pliable to allow for the removal and/or addition of communication cables without the necessity of drilling holes in the material.

E. The fire stopping material shall maintain/establish the fire rated integrity of the wall/barrier that has been penetrated.

F. Cable Contractor shall laminate and permanently affix to the MDF wall, adjacent to chases, the following information:
   1. Name of manufacturer of fire stop system.
   2. Part & model numbers of system and all components.
   3. Phone numbers of manufacturer's corporate headquarters in U.S. and local distributor's name and phone number.

END OF SECTION

SECTION 27 05 43
UNDERGROUND DUCTS AND RACEWAYS

PART 1 – GENERAL

1.1 SECTION INCLUDES

A. Provide all services, labor, materials, tools, and equipment required for the complete and proper installation of exterior telecommunications pathways as called for in these specifications and related drawings.

B. This section includes minimum requirements and installation methods for the following:
   1. Cutting and Patching Asphalt and Concrete
   2. Trenching and Excavation
   3. Underground Conduit Systems
   4. Cable Routing Hardware
   5. Horizontal Directional Drilling – Also commonly referred to as Directional Boring or Guided Horizontal Boring

1.2 SUMMARY

A. Incoming Service Duct-bank: The connection point for telecommunications services is an existing maintenance hole located northwest of the project site. The project shall provide four (4) 4” PVC Schedule 40 conduits, with pull-rope in each PVC conduit, direct-buried from the Galveston County Road and Bridge Office MDF right of way. (Refer to the Telecom Site Plan for details).

B. Primary Duct-bank: The primary telecommunications duct-bank will consist of ten (4) 4” PVC Schedule 40 conduits from the Office MDF to Maintenance shop. (2) 4” PVC Schedule 40 conduits from the Maintenance shop to warehouse. (2) 4” PVC Schedule 40 conduits from the warehouse to mosquito control. (1) 2” PVC Schedule 40 conduits from the warehouse to fuel/air station. (Refer to the Telecom Site Plan for details).

1.3 RELATED DOCUMENTS

A. Section 01 10 00 - Summary: Contract descriptions, description of alterations work, work by others, future work, occupancy conditions, use of site and premises, work sequence.

B. Section 01 20 00 - Price and Payment Procedures: Applications for payment, Schedule of Values, modifications procedures, closeout procedures.

C. Section 01 30 00 - Administrative Requirements: Submittal procedures, project meetings, progress schedules and documentation, reports, coordination.

D. Section 01 35 15 - LEED Certification Procedures.

E. Section 01 40 00 - Quality Requirements: Procedures for testing, inspection, mock-ups, reports, certificates; use of reference standards.

F. Section 01 57 13 - Temporary Erosion and Sedimentation Control.

G. Section 01 57 21 - Indoor Air Quality Controls: Procedures and testing; smoking room testing; LEED requirements.

H. Section 01 60 00 - Product Requirements: Fundamental product requirements, substitutions and product options, delivery, storage, and handling.

I. Section 01 70 00 - Execution Requirements: Examination, preparation, and general installation procedures; pre-installation meetings; cutting and patching; cleaning and protection; starting of systems; demonstration and instruction; closeout procedures

except payment procedures; requirements for alterations work.

J. See Section 01 74 19 - Construction Waste Management and Disposal.

K. Section 01 78 00 - Closeout Submittals: Project record documents, operation and maintenance (O&M) data, warranties and bonds.

L. Section 01 79 00 - Demonstration and Training: Detailed requirements.

M. Section 01 91 13 - General Commissioning Requirements.

N. Section 27 05 00 Basic Communications Requirements.

O. Section 27 05 26 Grounding and Bonding for Communications Systems.

P. Section 27 05 28 Pathways for Communications Systems.

Q. Section 27 05 53 Identification for Communications Systems.

R. Section 27 13 00 Backbone Cabling Requirements

1.4 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

1.5 QUALITY ASSURANCE

A. All installation work for the new exterior telecommunications pathways shall be performed in a neat and workmanlike manner. All methods of construction that are not specifically described or indicated shall be subject to the control of Owner.

B. Equipment and materials shall be of the quality and manufacture indicated. The equipment specified is based on the acceptable manufacturers listed. Where “approved equal” is stated, equipment shall be equivalent in every way to that of the equipment specified and subject to approval based on submittals provided.

C. Materials and work specified herein shall comply with the applicable requirements of:
1. ANSI/NFPA 70 – National Electrical Code including, but not limited to, the following articles:
   a. 314 – Outlet, Device, Pull-Boxes; Conduit Bodies; Fittings; and Vaults
   b. 344 – Rigid Metal Conduit: Type RMC
   c. 352 – Rigid Nonmetallic Conduit: Type RNC
   d. 358 – Electrical Metallic Tubing: Type EMT
   e. 384 – Strut-Type Channel Raceway
2. IEEE/NESC – National Electrical Safety Code
3. NEMA Standards including, but not limited to:
   a. NEMA, RN1, 1986 PVC Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit.
   b. NEMA, TC3, 1982 PVC Fittings for use with Rigid PVC Conduit and Tubing.
   c. NEMA, TC6, 1983 PVC and ABS Plastic Utilities Duct for Underground Installation.
   d. NEMA, TC8, 1983 Extra Strength PVC Plastic Utilities Duct for Underground Installation.
   e. NEMA, TC9, 1983 Fitting for ABS and OVC Plastic Utilities Duct and Fittings for Underground Installation.
   f. NEMA, TC10, 1983 PVC and ABS Plastic Communications Duct and Fittings for Underground Installation.
4. UL Standards including, but not limited to:
   a. UL 6, 1981 Rigid Metal Electrical Conduit
   b. UL 651 1981 Schedule 40 and 80 PVC Conduit

5. ANSI-C80.2, 1983 Specification for Rigid Steel Conduit, Enameled
6. ANSI/TIA/EIA-569-B – Commercial Building Standard for Telecommunications Pathways and Spaces.
7. ANSI/TIA/EIA-607-C-2015 – Commercial Building Grounding and Bonding Requirements for Telecommunications
8. ANSI/TIA/EIA-758-A-2017 – Customer Owned Outside Plant Telecommunications Cabling Standard (including all applicable addenda)
9. BICSI Telecommunications Distribution Methods Manual
10. BICSI Customer-Owned Outside Plant Manual

D. For horizontal directional drilling, the Contractor shall follow all procedural precautions necessary to ensure that the essential aspects of proper directional bore installation are adequately controlled.

E. Personnel for horizontal directional drilling shall be fully trained in safety and their respective duties as part of the directional drilling crew.

1.6 WARRANTY

A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.

PART 2 – PRODUCTS

2.1 TRENCH/BACKFILL MATERIALS

A. Trenching and Excavation Backfill: Select fill materials as specified in Section 01 57 13.

B. Concrete Slurry: Select Flow Fill as specified in Section 01 10 00

C. Concrete Pavement: Select concrete paving materials as specified in Section 01 60 00

D. Asphalt Pavement: Select asphaltic paving materials as specified in Section 01 60 00

2.2 CONDUIT SYSTEM

A. Non-Metallic Conduit:
1. PVC plastic pipe, ASTM D1785, Schedule 40, Type PVC 1120.
2. Tone Tape, Arnco DL WP12LC Tone Tape, or equivalent.

B. Conduit Joint Couplings:
1. PVC non-metallic fittings must be installed with solvent applied couplings.
2. An approved transition coupling shall be used to connect metal to plastic (PVC) conduits.
3. Couplings may be threaded and / or glued to provide watertight seal at conduit junctions.

C. Electrical Metallic Tubing (EMT): Electro-galvanized steel tubing 3/4” and larger diameter per project requirements.
1. Conduit joint couplings and connectors: steel double set screw indenter fittings.
2. Metal bushings for 3/4” and 1” conduit.
3. Insulated metallic bushings for 1-1/4” and larger conduit.
4. Insulated metallic bushings with grounding lugs as required.
5. Conduit sweeps: minimum 10 times the conduit inside diameter.
6. Include required conduit straps, and hangers, heavy-duty malleable iron or steel. Perforated pipe strap or wire hangers are not permitted.

D. Inside Pull-Boxes: Reference Section 27 05 28 for inside pull-boxes for conduit entering building.

E. Outside Pull-Box: Minimum 14-gauge galvanized steel with weatherproof locking cover and hardware for surface mounting as required for project. Dimensions as required for

project.

F. Test mandrel shall be ¼" smaller than inside conduit diameter and not less than 12 inches long.

G. Pull-rope: 1/4" Nylon pull rope.

H. Core Drill Seals for Outside Building Walls: Link-Seal waterproof assembly or equal. Manufactured by PSI/Thunderline/Link-Seal, 6525 Goforth Street, Houston, TX 77021.

I. Conduit Caulking Compound: Compounds for sealing conduit ducts shall have putty-like consistency workable with the hands at temperatures as low as 35 degrees Fahrenheit, shall not slump at a temperature of 300 degrees Fahrenheit, and shall not harden materially when exposed to the air. Compounds shall readily caulk or adhere to clean surfaces of plastic conduit, metallic conduits, or conduit coatings; concrete, masonry; any cable sheaths, jackets, covers, or insulation material, and the common metals. Compounds shall form a seal without dissolving, noticeable changing characteristics, or removing any of the ingredients. Compounds shall have no injurious effect on the hands of workers or upon materials.

J. Underground Plastic Line marker: Manufacturer's standard permanent, continuous-printed polyethylene film tape with metallic core, intended for direct burial service; not less than 3" wide x 4 mils thick. Provide orange tape with black printing reading, "CAUTION TELEPHONE/DATA CABLE BELOW," or similar.

K. Ground Wire: Bare Copper # 6

L. Tracer Box: NEMA-3 4" x 4" weatherproof box

M. Spacers for 4" Conduit: Carlon S289NJN Intermediate Spacer and S288NJN Base Spacer

PART 3 – EXECUTION

3.1 INSPECTION

A. Examine areas and conditions under which the new exterior telecommunications pathways are to be installed. Provide notification, in writing, of conditions detrimental to proper completion of the work.

B. Verify field measurements and pathway routing conditions are as shown on drawings. Provide notification, in writing, of conditions deviating from drawings.

C. Beginning of telecommunications pathway installation indicates Contractor acceptance of existing conditions.

3.2 EXCAVATING, TRENCHING AND BACKFILLING:

A. General: The work hereunder includes whatever excavating and backfilling is necessary to install the voice and data communications work. Coordinate the voice and data communications work with other work in the same area, including excavating and backfilling, dewatering, floor protection provisions, other temporary facilities, other underground services (existing and new), landscape development, paving, structural foundations, and floor slabs on grade. Coordinate with weather conditions and provide temporary facilities needed for protection and proper performance of excavating and backfilling.

B. Standards: Except as otherwise indicated, comply with the applicable provisions of Division 2 for voice and data communications work excavating and backfilling. Refer instances of uncertain applicability to the Architect/ Engineer for resolution before proceeding with the Work.

C. Coordinate excavating, trenching and backfilling with Landscaping, Civil, Mechanical, Plumbing and Electrical drawings. Voice and Data Communications duct-banks shall be independent of any other systems.

D. Refer to Civil contract documents for information regarding required depths, slope and grade and additional information regarding trenches. Where these documents and the civil documents differ, bring any such differences to the attention of the engineer prior to construction. The bottom of the trench shall be accurately excavated to provide firm, uniform bearing for the bottom of the raceways and duct-banks. Where mud or unstable soil is encountered in bottom of trench, it shall be removed to firm bearing and the trench shall be backfilled with bedding sand to proper grade and tamped to provide uniform firm support.

E. The bottom of trenches shall be accurately graded to provide proper fall and uniform bearing and support for each section of the conduit on undisturbed soil or 2" of sand fill at every point along its entire length. In general, grading for voice and data communications duct-banks and conduits shall be from building to vault, and from a high point between vaults to each vault.

F. Exercise care not to excavate below required depth, leaving a flat bed of undisturbed earth, firm and secure, before laying conduit. In the event rock is encountered, excavate 6" below required depth and backfill to required depth with bedding sand, and compact to minimum 95% compaction.

G. 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 site and properly disposed of.

H. The Contractor shall be fully responsible for the safety of persons, materials and equipment in or near trenches or other excavations and provide all required sloping, shoring, railings and other protective provisions. The Contractor shall provide a trench shoring plan and design which is sealed by a registered professional engineer. Refer to Divisions 1 and 2 for additional requirements.

I. If any unknown and/or uncharted utilities are encountered during excavation, promptly notify Architect/ Engineer and wait for his instructions before proceeding.

J. If such unknown utilities are encountered and work is continued without contacting the Architect/ Engineer for instructions, and damage is caused to said utilities, the Contractor shall repair at his own expense, such damage to the satisfaction of the owner or utility company concerned.

K. Trenches shall not be backfilled until all required tests have been made by the Contractor and approved by the Architect/Engineer and any local authorities having jurisdiction.

L. Backfill shall be cement stabilized sand up to 6" above the top of conduit or duct-bank as required by code. Backfill up to grade shall be in maximum 6" lifts with minimum 95% compaction of lifts. Refer to Division 2 or elsewhere in Contract Documents for additional trenching and backfill requirements.

M. Opening and Re-closing Pavement, Landscape Areas and Lawns: Where excavation requires the opening of existing walks, street, drives, other existing pavement or lawns, such surfaces shall be cut as required to install new conduit and to make new connections to existing conduits. 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 or replaced, using materials to match those cut out or removed. Patches shall thoroughly bond with the original surfaces, shall be level with them, and shall meet all the requirements established by the authorities having jurisdiction over such areas. All removed work shall be replaced by craftsman who regularly installs the types of work being replaced.

N. 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' 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 Architect before they are cut or damaged in any way. The Architect 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.

O. Perform all trenching and backfill for new underground conduit system placement as shown on the project drawings.

P. Perform pavement marking as required as specified in Section 02 58 00.

Q. All utilities to be located by contractor and exposed, if necessary, prior to construction.

3.3 CONDUIT SYSTEM PLACEMENT

A. Place new conduit system including maintenance holes as shown on the project drawings.

B. Twelve-inch (12") clearance from all utilities to be maintained. If not possible, conduit to be encased in concrete slurry (flow fill) where proper distance cannot be obtained.

C. Cross telecommunications conduit ducts below gas piping.

D. All conduits shall be thoroughly cleaned before laying or using.

E. During construction the ends of the conduits shall be plugged to prevent water washing mud into the conduits, vaults, or buildings. Particular care shall be taken to keep the conduits clean of concrete, dirt or any other substance during the course of construction.

F. New and reopened trenches under asphalt roadways and parking lots must have concrete cap or be encased in concrete as required.

H. Support multiple conduits on preformed nonmetallic separators to provide not less than 1" spacing between exterior surfaces of conduit (Type 5). Spacing between separators shall be close enough to prevent sagging of conduits or breaking of couplings and watertight seals.

I. Squeegee is to be placed in the trench for 20' on each side of the vaults (Type 4).

K. Conduits shall be securely anchored in place with nylon tie-downs to prevent movement during the placement of concrete slurry (flow fill), squeegee, and other backfill materials. Wire tie-downs are prohibited.

L. Seal all conduit junctions and fittings watertight prior to pour of concrete slurry (flow fill). Conduit couplings shall be made in accordance with the manufacturer's recommendation

for the particular type of conduit and coupling selected and as approved.

M. Unless otherwise noted on drawings, a minimum two-foot (24”) depth of cover is required above the top of all conduits.

N. Provide communication drain box in conduit six feet (6’) from building outside wall penetrations as shown in project drawings. Conduit inside drain box shall be perforated to allow water and gas to escape.

O. Transition to PVC coated GRC conduit five feet (5’) from building outside wall penetrations.

P. For all offsets and sweep bends, provide fiberglass or PVC coated GRC.

Q. All conduit bends are to be minimum 3’ radius or larger as noted on drawings.

R. Bury underground plastic line marker one foot (12”) above the telecommunications conduit.

S. Cast into concrete a #6 bare copper ground wire directly above the telecommunications conduit and extend 4” into each vault space. Extend 6” of tracer wire into tracer box on outside wall of building directly above conduit entry point.

T. Provide plastic conduit bell ends at each PVC conduit termination and for all conduit entering vaults.

U. Do not bore under concrete sidewalks, remove and replace sidewalks as necessary.

V. The new conduit shall extend through the wall into the building, tunnel, or crawl space a minimum of 4 inches.

W. Building, tunnel, and vault core drills must be sealed around conduits with approved waterproof plugging compound.
   1. Seal openings around conduits that pass through inside building wall core drills with UL listed foamed silicone elastomeric compound.
   2. Seal openings around conduits that pass through outside building walls with a complete Link-Seal assembly or equal for a waterproof seal. Slope conduit away from building.
   3. Seal openings around conduits that pass-through vault walls with foundation foam on the interior of the core and silicone sealer on the inside and outside of the core for a waterproof seal.

X. Maintenance Holes (MH) shall be placed with the long dimension in line with the main conduit run. The conduit shall enter opposite ends of the MH on the short sides so that the MH shall not be used as a 90-degree bend in cable installations.

Y. The ends of the metallic conduit shall be reamed and bushed using:
   1. Insulated metallic bushings for 1-1/4” conduit and larger
   2. Insulated metallic bushings with grounding lugs for conduit entering TRs and ERs

Z. After conduit duct installation has been completed and concrete has set, pull “D” test mandrel through all new conduit ducts to verify duct integrity and ensure smooth interior surfaces free from burrs or obstructions that might damage cable sheaths.

AA. Following mandrel testing, draw cylindrical wire brush with stiff bristles through each conduit to clean the conduit and remove any concrete, dirt or other obstructions.

BB. Stub out conduits into ERs, TRs, and cabinets only enough to attach connector and bushings with grounding lugs except conduits shall rise a minimum of 6 inches above the finished floor.

CC. Install new pull rope in all new conduit and extending three feet into each building space.

DD. Plug ends of the new conduit with watertight rubber conduit plugs, conduit caulking compound, or conduit caps to ensure foreign matter does not enter the buildings.

EE. Refer to Owner prior to cutting or drilling any surface.

3. 4 CABLE ROUTING HARDWARE

A. Place new cable routing hardware in the tunnels and in crawl spaces beneath the building as required for the project and as shown on the drawings.

B. Perform installation of routing hardware as specified in Section 270526 including anchoring and supports, grounding and bonding, etc.

C. Place new ladder, pulling-in irons, cable racks, “S” rack supports, steps in new and existing vaults as required for backbone cable routing.

3.5 HORIZONTAL DIRECTIONAL DRILLING

A. Owner shall be notified 48 hours in advance of starting horizontal directional drilling work. The directional drilling shall not begin until Owner is present at the job site and agrees that proper preparations for the operation have been made.

B. No work shall commence until Traffic Control and Construction Permits from Owner and/or the City are in place as applicable for the specific project.

C. Site Preparation
1. Prior to any alterations to work site, the entry and exit points shall be marked.
2. No alterations to the work site beyond what is required for operations shall be made.
3. All activities shall be confined to designated work areas.

D. Drill Path Survey
1. The entire drill path shall be accurately surveyed with entry and exit stakes placed in the appropriate locations within the areas indicated on drawings.
2. If a magnetic guidance system is being used, the drill path will be surveyed for any surface geomagnetic variations or anomalies.

E. All applicable environmental regulations shall be adhered to.

F. Following drilling operations, the equipment will be de-mobilized, and the worksite restored to its original condition. All excavations will be backfilled and compacted to 95% of original density. Landscaping will be restored to original site conditions.

3.6 SAFETY

A. The contractor must comply with Owner regulations for asbestos, lead, and confined spaces.

B. All applicable state, federal and local safety regulations shall be adhered to and all operations shall be conducted in a safe manner.

C. Guard vault openings per NESC C-2-1997, 423.A:
1. When covers of maintenance holes are removed, the opening shall be promptly protected with a barrier, temporary cover, or other suitable guard.

D. Test for gas in vaults and unventilated vaults per NESC C2-1997, 423.B and C, including, but not limited to:
1. The atmosphere shall be tested for combustible or flammable gases before entry.
2. Where combustible or flammable gases are detected, the work area shall be ventilated and made safe before entry.

3. Unless forced continuous ventilation is provided, a test shall also be made for oxygen deficiency.
4. Provision shall be made for adequate continuous supply of air. Note: The term adequate includes evaluation of both the quantity and quality of the air.
5. Employees shall not smoke in vaults.
6. Where open flames must be used in vaults or vaults, extra precautions shall be taken to ensure adequate ventilation.

3.7 AS-BUILT DRAWINGS

A. Mark the project drawings with notations reflecting any variations from the base specifications and drawings including as-built conduit routing.

B. Comply with Construction Drawings As-Built Requirements attached to Section 01 78 00 Closeout Submittals.

END OF SECTION

SECTION 27 05 53
IDENTIFICATION FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Documentation practices and requirements of cables, termination hardware, patching and cross-connection facilities, conduits, other cable pathways, Telecommunications Rooms, and other telecommunications spaces.

1.2 RELATED DOCUMENTS

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

1.3 SUMMARY

A. This Section specifies the requirements for the Identification for Communications Systems for the Galveston County Road and Bridge Facility.

B. Work covered by this Section shall consist of furnishing labor, equipment and materials necessary for the labeling of the telecommunications infrastructure as described on the Drawings and/or required by these specifications.

1.4 QUALITY ASSURANCE

A. Identification and administration work specified herein shall comply with the latest applicable requirements of:
   1. ANSI/TIA/EIA - 606-A-2011 Administration Standards.
   2. ANSI/TIA/EIA - 569 Pathway and Spaces
   3. ANSI/TIA/EIA - 568-B Telecommunications Cabling Standard.
   4. BICSI Telecommunications Distribution Methods Manual.
   5. UL 969.

1.5 TELECOMMUNICATIONS ADMINISTRATION

A. Administration of the telecommunications infrastructure includes documentation of cables, termination hardware, patching and cross-connection facilities, conduits, other cable pathways, Telecommunications Rooms, and other telecommunications spaces. All Galveston County facilities shall apply and maintain a system for documenting and administering the telecommunications infrastructure.

B. Telecommunications Infrastructure Records must be maintained in a computer spreadsheet, or in a computer database. Paper records are encouraged but are optional. A cable record is prepared for each backbone cable. The record will show the cable name and must describe the origin point and destination point of the cable. The cable record will record what services and/or connections are assigned to each cable pair or strand. An equipment record is prepared for services distributed from a certain piece of equipment, such as a router, or a system such as the telephone system PBX.

C. Installer shall maintain accurate, up-to-date Installation or Construction Drawings. At a minimum, the Installation Drawings shall show pathway locations and routing, configuration of telecommunications spaces including backboard and equipment rack configurations, and wiring details including identifier assignments.

D. Installer shall provide a complete and accurate set of as-built drawings. The as-built drawings shall record the identifiers for major infrastructure components including; the pathways, spaces, and wiring portions of the infrastructure which may each may have separate drawings if warranted by the complexity of the installation, or the scale of the drawings.

PART 2 - PRODUCTS

2.1 MANUFACTURERS
- A. Panduit
- B. Brady Corporation
- C. Equivalent

2.2 LABELS

A. Shall meet the legibility, defacement, exposure and adhesion requirements of UL 969.

B. Shall be preprinted or computer printed type. Handwritten labels are not acceptable.

C. Where insert type labels are used provide clear plastic cover over label.

D. Outside plant labels shall be totally waterproof even when submerged.

E. Equipment Room Copper, Fiber, and Coax Backbone Cable Labels
1. Panduit Part#LS7-75NL-1 or Brady#WML-1231-292

F. Equipment Room Copper, Fiber, and Coax Horizontal Cable Labels
1. Panduit Part#LS7-75NL-1 or Brady#WML-317-292

G. Work Area Copper, Fiber, and Coax Riser Cable Labels
1. Panduit Part#LS7-75NL-1 or Brady #WML-317-292

H. Patch Panel Labels
1. Panduit Part #LS7-38-1 or Brady #CL-111-619

PART 3 - EXECUTION

3.1 IDENTIFICATION & LABELING

A. The size, color, and contrast of all labels should be selected to ensure that the identifiers are easily read. Labels should be visible during the installation of and normal maintenance of the infrastructure.

B. Labels should be resistant to the environmental conditions at the point of installation (such as moisture, heat, or ultraviolet light), and should have a design life equal to or greater than that of the labeled component.

C. All labels shall be printed or generated by a mechanical device.

3.2 TELECOMMUNICATION IDENTIFIERS

A. Work Area Outlet cabling shall be clearly marked using permanent means. Work Area Outlet shall use the following system of numbering and labeling:

1. Category 6 label to be installed 2” from termination point.
   a. Identify: the communications room name, patch panel number, and port number.
      1. Example: MDF - 01 - 01

B. Outside Plant cabling shall be clearly marked using permanent means. Outside plant shall use the following system of numbering and labeling:

1. Fiber Optic:
   a. Identify: far-end building name, building number, fiber-type and strand-count
   b. Label at entrance and exit points of tunnel system and at conduit entry points between 12 inches and 36 inches from the conduit or at closet point that is clearly visible, and long cable length in tunnel at 200-foot intervals.
   c. Label at termination panels at both ends.

2. Copper:
    a. Identify: far-end building name, building number and strand-count
    b. Label at entrance and exit points of tunnel system and at conduit entry points between 12 inches and 36 inches from the conduit or at closet point that is clearly visible, and long cable length in tunnel at 200-foot intervals.

C. Riser cabling shall be clearly marked using permanent means. Riser cabling shall use the following system of numbering and labeling:
1. Fiber Optic:
    a. Identify: far-end MDF/IDF, fiber-type and strand-count.
2. Copper:
    a. Identify: far-end MDF/IDF and pair-count
    b. Termination points shall be labeled as to actual pair at every fifth (5th) pair-point.

3.3 LABELING PROCEDURES

A. To be consistent with ANSI/TIA/EIA standards and industry practices, it is important that both labeling and color coding be applied to all telecommunications infrastructure components. Labeling with the unique identifier will identify a particular component. Proper color coding will quickly identify how that component is used in the overall telecommunications infrastructure of the facility.

B. Visibility and durability
1. The size, color, and contrast of all labels should be selected to ensure that the identifiers are easily read. Labels should be visible during the installation of and normal maintenance of the infrastructure.
2. Labels should be resistant to the environmental conditions at the point of installation (such as moisture, heat, or ultraviolet light), and should have a design life equal to or greater than that of the labeled component.
3. Labels are generally of either the adhesive or insert type. All labels must be legible, resistant to defacement, and maintain adhesion to the application surface.
4. Outside plant labels shall be totally waterproof, even when submerged.
5. Labels applied directly to a cable shall have a clear vinyl wrapping applied over the label and around the cable to permanently affix the label.
6. Other types of labels, such as tie-on labels, may be used. However, the label must be appropriate for the environment in which it is used and must be used in the manner intended by the manufacturer.

C. Mechanical generation
1. All labels shall be printed or generated by a mechanical device.

END OF SECTION

SECTION 27 11 00
COMMUNICATIONS EQUIPMENT ROOM FITTINGS

PART 1 – GENERAL

1.1 SECTION INCLUDES

A. Equipment room fittings for MDF/IDF facilities.

1.2 RELATED SECTIONS

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

B. Section 27 05 00 – Communications Common Work Results

1.3 SUMMARY

A. This Section specifies the requirements for the Communications Equipment Room Fittings for the Galveston County Road and Bridge Facility

B. Communications Equipment Room Fittings
1. The communications service entrance pathway will consist of a minimum of four (4) 4” conduits from the Building Entrance Point to the MDF.
2. Space for new outside plant copper and fiber optic cable and terminating hardware mounted in contractor provided 19” racks will be provided in the MDF.
3. MDF and IDF facilities shall include the following:
   a. MDF Room: Shall not be less 7’ 8” X 10’
      Minimum ceiling height is 9’ 6”

   b. IDF Room in Maintenance Shop: Shall not be less 7’ 8” X 8’
      Minimum ceiling height is 9’ 6”

   c. 24/7 environmental controls - 20 °C to 21 °C (68 °F to 70 °F). The humidity range should be 30% to 55% relative humidity.
   d. No false ceilings or water pipe within the room’s interior or running horizontally on the floor above.
   e. Light fixture height a minimum of 8.5 ft AFF, with a minimum equivalent of 500 lux (50 foot candles) measured 3' AFF, with 30% emergency light fixtures, if available. Fluorescent lighting is prohibited. Use LED bright white lighting.
   f. Dedicated Telecom Room power panels fed from UPS distribution, if available.
   g. Convenience electrical outlets shall be installed on a side wall to allow for power cables to be run along relay racks, minimizing possibility of tripping hazards.
   h. A minimum of one (1) duplex convenience outlet shall be placed at 6 foot intervals around perimeter walls immediately to the left and right of the door for general purpose use. Duplex utility outlets shall be placed at a 18 inches AFF.
   i. At a minimum, one 240 volt 30 AMP dedicated circuit with a NEMA L6-30R receptacle and one 240 volt 20 AMP dedicated circuit with a NEMA 5-20R receptacle shall be installed at a height of seven (7) feet AFF. Both conduit and outlets shall be connected to the outside of the basket tray facing rear of the relay racks.
   j. At a minimum, there shall be four (4) 120 volt 20 AMP dedicated outlets with each pair on a dedicated circuit with emergency generator back-up. These outlets are to be located at a height of seven (7) feet AFF and both conduit and outlets shall be connected to the outside of the basket tray facing the rear of the equipment racks. Final design and layout approval on the number, type and location of the outlets shall be provided by ITNO.
   k. At a minimum, there shall be one (1) 20-amp 120-volt single phase circuit per rack. All telecommunication circuits shall be clearly labeled on circuit breaker panels with the circuit identification number located on the faceplate of the outlet in the

telecommunications room.

l. ¾ “void-free” AC-grade marine plywood on all walls, 8 ft high, painted with at least two coats of light colored fire retardant paint. Fire Marshall to inspect and approve before painting. Paint should be equivalent to: Flame Control Coatings, LLC. Flame Control NO. 20-20A. Fire Hazard Classification, ASTM E-84 (NFPA 255) Class “A”.
m. A Telecommunications Main Grounding Bus Bar (TMGB) in the MER and Telecommunications Grounding Bus Bar (TGB) in the TR and a Bonding Conductor for Telecommunications (BCT) that bonds the TMGB to the electrical power ground compliant with ANSI J STD-607 C Standards
n. Equipment racks and overhead runway (ladder rack) system as shown in T-drawings.
o. 4” riser sleeves between stacked ER/TRs as shown in T-drawings.
p. Building Entrance stub-ups as shown in T-drawings.
q. Cage covered fire suppression elements
r. A floor rating greater than 50 lbf/ft2 distributed loading
s. Fully-opening, secured, lockable, solid-core doors that are at least 3 ft wide and 6.7 ft [80 in]) tall and open outwards from the room.
t. Rooms shall not provide for pass-through or over-head conduits serving plumbing, HVAC or electrical services, except for sprinkler systems.
u. No panels for electrical or other services shall be contained in a TR/ER.
v. Rooms shall be located to maintain compliance with TIA/EIA distance limitations and stacked vertically whenever possible.
w. Conduits entering room shall be located within 4” of wall and conduit outer diameter and stubbed 2” into room.
x. An additional two conduits, sleeved cores or cable tray, over and above the current requirements shall be included for future growth.
y. Appropriately sized UPS shall be installed in every Telecommunication Room and in Equipment Rooms having rack-mounted equipment/hardware. ITNO will determine appropriate UPS devices.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Equipment Racks – Heavy duty aluminum 7’ floor mounted racks with cable management channels on both sides and mounting rails for 19” equipment are required.
   1. Chatsworth Products Inc.
      a. Relay Rack - 55053-703
      b. Grounding Bar – 13622-012

B. Vertical Cable Management
   1. Chatsworth Products Inc.
      a. Combination Cabling Section - 30162-703

C. Horizontal Cable Management
   1. Panduit Products
      a. 1U - NCMHF1
      b. 2U - NCMHF2

D. Basket Cable Tray
   1. Cablofil
      a. 12” x 2” – CF54 /300 EZ
      b. 12” X 4” – CF105 / 300 EZ

E. Wall Mounted Equipment Cabinet.
   1. Chatsworth Products Inc.
      a. Cabinet 11840

2.1 RELAY RACKS

A. Equipment racks shall be capable of accepting 19” equipment, self-supporting and manufactured from high-strength aluminum with two top brackets included for additional strength.

B. Finish color shall be black. Mounting holes shall be drilled and tapped each side at 5/8”-5/8”-1/2” patterns compatible with EIA 1-1/4”-5/8” alternating patterns.

C. The rack shall include base flanges with mounting holes drilled through for securing the rack to the floor. Each mounting hole must be at least 5/8” in diameter.

D. Where the rack is to be mounted to VCT flooring or bare concrete, an insulating pad must be used, and care must be taken that anchors, used to secure the rack to the floor, do not come in contact with any reinforcing steel embedded in the concrete slab.

E. In the Telecommunications and Equipment Rooms a minimum of six (6) rack mount spaces are reserved at the top of each rack for fiber enclosures.

2.3 CABLE MANAGEMENT

A. Vertical cable management shall be double-sided and narrow or wide depending upon application requirements. Each manager section shall have a black finish. Lockable latching sections and protective edge guards shall be included.

B. Horizontal cable management shall be capable of attachment to a 19” rack, maximum 6” deep and maximum 2.8” high. Each manager shall have a black finish.

2.4 CABLE RUNWAY

A. Subject to compliance with these specifications, cable runway shall be as manufactured by Chatsworth Products, Inc. Cable runway (ladder rack) is required within the ER/TR's to provide a suitable pathway to route all cabling into and out of termination equipment, mounted in equipment racks or on backboards attached to walls, and pathway spaces beyond the ER/TR.

B. Runway: Provide UL classified cable runway and components. Such products are to be UL classified as to its suitability as an equipment-grounding conductor. Cable runway and components are to have rounded edges and smooth surfaces in compliance with applicable standards, and with the following additional construction features:
   1. Dimension: The cross sectional area of the side rail shall be greater than 0.20 square inches. The height of the side rail must remain at 1-1/2 inches.
   2. Material and Finish: All cable runway and components shall be made of tubular steel and finished with flat black powder coat paint or gold chem film over zinc plating.
   3. Construction: Cable runway is a prefabricated metal structure consisting of two longitudinal side rails connected by individual transverse members. Cable runway shall be constructed of 1-1/2” x 3/8” x .065” rectangular steel tubing. Cross members shall be a single continuous rectangular tube ½” x 1' x .065” with radiused corners. Cross members shall be welded to stringers at 9” intervals with ends finished to protect installers and cables.
   4. Cable runway width shall be 12 inches except as otherwise shown on the Telecommunications Drawings.
   5. Cross members shall be spaced every 9 inches at a minimum.

C. UL Classified Runway Butt-Splice Kit: Consists of 4 splice plates, U-shaped. Overall, 5” by 5/8” by 11/16” thick. Provided with 7/16” by 3/8” cutout for insertion of trimmed head bolt. Bolt measures 3/8” diameter by 2-1/2” long provided with hex nut and lock washer.

D. UL Classified Runway Junction Splice Kit: L-shaped splice angles. Overall, 2” x 2” by 1-1/2”, 3/16” thick. Secured to cable runway by 3/8” diameter by 1-1/2” hex bolts, nuts and lock washers.

E. UL Classified 90 Degree Runway Splice Kit: Outside Clamp - Overall, 5-3/4” x ¾” by 5/8”, minimum 0.10 thick. Provided with 7/16” by 7/16” cutout for insertion of trimmed head bolt. Bolt measures 3/8” diameter by 3-1/4” long. Provided with hex nut and lock washer. Inside Edge

Clamp - Overall, 2-9/16” x 15/16” x 5/8”, minimum 0.10 thick. Provided with 7/16” x 7/16” cutout for insertion of trimmed head bolt.

F. UL Classified 45 Degree Runway Splice Kit: Outside Clamp - Overall, 4-7/16” x 5/8” x ¾”, minimum 0.10” thick. Provided with 7/16” x 7/16” cutout for insertion of trimmed head bolt. Bolt measures 3/8” diameter by 2-11/16” long provided with hex nut and lock washer. Inside Edge Clamp - Overall, 2-9/16” x 15/16” x 5/8” minimum 0.10” thick. Provided with 7/16” x 7/16” cutout for insertion of trimmed head bolts.

PART 3 - EXECUTION

3.1 GENERAL

A. ER / TR
1. Cabling within Racks and Enclosures: provide adequate length of cabling. Train conductors to termination terminal points that follow manufactures installation procedures for maintaining cable performance specifications. Provide lacing/mounting bars to restrain cables, to prevent straining connections, and to stop bending cables to smaller radii than minimums recommended by manufacturer.
2. Equipment Racks: Provide 19” wide x 7'-0” tall racks with number of vertical rack sections as required to allow space for termination of all fiber and data/voice cabling plus mounting space for multi-port concentrators (Hub/Switches) required to cross-connect all data jacks.
3. Locate/space racks and enclosures according to EIA/TIA guidelines for front and around access.
4. Vertical wire management: double-sided vertical rack cabling sections. Reference T. Drawings
5. Entrance: Arrange and coordinate locations of distribution frames, patch panels, cross-connections in communication rooms and racks to optimize space requirements of any service provider requirements, telephone system and LAN equipment.
6. Provide cable runway in equipment room above all racks and up to runway/conduits/sleeve's entering room from corridors to form a complete runway system connecting all hardware installations. Attach grounding lugs to each rack/cable raceway, conduit, etc. Refer to 'T' drawings for details.
7. Install trays overhead along the equipment rows, leading to the cross-connects. Coordinate tray locations with lighting, air-handling systems, and fire extinguishing systems so that fully loaded trays will not obstruct or impede their operation. In the United States, NEC Article 392 provides requirements for cable trays.
8. Provide horizontal cable runways. Equip each 19” rack with overhead ladder style cable runway installed between the wall and horizontal/equipment racks. Refer to COMMUNICATIONS “T” drawings for proposed locations and sizing of each runway. Securely attach to wall studs with support brackets (and racks if applicable), in accordance with manufacturer written instructions.
9. Provide ground lug for each 19” rack. Racks shall be grounded to wall mounted ground bus bar using #6 AWG stranded, green jacketed, insulated copper conductor. Furnish all required bonding material and hardware, and bond to building grounding electrode subsystem TMGB in ER. If crimp connectors are used to bond the #6 AWG wire, follow NEC bonding procedures/specifications.
10. An inert dielectric material shall separate dissimilar metals apt to corrode through electrolysis under the environmental operating conditions specified.

END OF SECTION

SECTION 27 13 00
COMMUNICATIONS BACKBONE CABLING

PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SECTION INCLUDES

A. Work covered by this Section shall consist of furnishing labor, equipment, supplies, materials, and testing in performing the following operations recognized as necessary for the installation, termination, and labeling of copper and fiber backbone infrastructure as described on the Drawings and/or required by these Specifications.

B. Products

C. Installation Requirements

D. The building backbone riser system connects Telecommunication Rooms to each other. Galveston County specifies separate cable systems to provide data, and voice needs. The backbone riser system consists of plenum-rated, multi-pair twisted pair copper cables, coaxial, and single mode fiber cables along with associated termination systems.

1.3 RELATED SECTIONS

A. 27 05 00 Common Work Results for Communications

B. 27 05 53 Identification for Communication Systems

1.4 COORDINATION

A. New cable plant requiring connection to, or disconnection from, the Galveston County networks shall be performed by personnel designated by Information Technology Network Operations. Campus networks include; telephone, local and wide area, and fiber optic networks.

B. Contractor shall coordinate the work specified in this Section with the work in other parts of the Contract documents.

B. Plans in general are diagrammatic. It is the full responsibility of the Contractor to be familiar with the location of equipment involved under the work of other trades to eliminate conflicts between the fiber and copper cable installation and the work of other trades.

C. All questions and issues with regard to coordination shall be directed to the Owner.

1.4 SUBMITTALS

A. Manufacturer’s data, including part numbers, cut sheets and detailed descriptions, for all proposed equipment.

B. Cable inventory data shall be submitted for all fiber, copper, and coaxial cabling and termination equipment. Submit data electronically in "Microsoft Excel 2007" format, listing products furnished, including:
   1. Manufacturer's name.
   2. Manufacturer's part numbers and com code numbers.
   3. Cable numbers utilizing the UH Information Technology Network Operations’ cable numbering standard.
   4. Location and riser assignments.
   5. This requirement applies to copper cable, fiber optic cable, and all termination equipment.

C. Record Drawings: Furnish CAD drawings of completed work including cable numbers. Refer to item Section 27 05 53 for labeling conventions. Contractor's on-site Building Industry Consulting Services International (BICSI) Registered Communications Distribution Designer (RCDD) supervisor shall review, approve and stamp all shop drawings, coordination drawings and record drawings.

D. Cable Testing Reports.Submit Testing Plan prior to beginning cable testing.
   1. Submit certified test reports of Contractor-performed tests in accordance with this document.
   2. Electronic versions of test reports shall be submitted together and clearly identified with cable identification.
   3. Test reports shall be reviewed, approved and stamped by the Contractor's on-site RCDD.

E. Product data for all termination and test equipment to be used by Contractor to perform work.
   1. Equipment shall be calibrated with traceability to National Institute of Standards and Technology (NIST) requirements.
   2. Contractor shall include copy of calibration and certification that equipment calibration meets NIST standards and has been calibrated at least once in the previous calendar year.
   3. Test equipment data shall be reviewed, approved and stamped by the Contractor's on-site RCDD prior to submitting.

F. Submit Cable Pulling Plan, as follows:
   1. Indicate the installed backbone conduit layout in schematic format, including junction boxes and distances between junction boxes.
   2. Indicate contents of each conduit.
   3. Indicate the cable pulling calculations, conduit fill ratios and actual cable runs and tensions.
   4. Cable Pulling Plan shall be reviewed, approved and stamped by the Contractor's on-site RCDD prior to submittal.
   5. Installation of cabling shall not commence prior to approval of the pulling plan and calculations by the Architect/Engineer.

G. The Contractor shall submit installation plan indicating:
   1. Equipment and personnel
   2. Materials and staging area
   3. Start and completion dates
   4. Locations, including floor, room and building
   5. Installation plan shall be reviewed, approved and stamped by the Contractor's on-site RCDD prior to submitting.

H. The Contractor shall submit a copper cable pulling plan for all multi-pair copper cables with a pair count of 25 pairs or greater, that includes, but is not limited to, the following:
   1. Each cable run and route.
   2. Date and duration of the pull.
   3. Pulling methodology and equipment setups.
   4. Pulling tension calculations for each pull in the run.
   5. Safety issues and precautions to be taken.

I. Cable Splicing Submittals
   1. Fiber fusion splicing method and procedures.
   2. Schedules of copper and fiber cables to be spliced.
   3. Copper splicing method and procedures.
   4. Certification documents for all splicing personnel.

5. Cut sheets, showing accurately scaled components, of fiber and copper splice closures, accessories, clamps, brackets, hangers, splice connectors, splice joint assemblies and fittings.

J. Shop Drawing Submittals to include:
1. Room penetration plan / drawing
2. Communication extension pathway plan / drawing
3. Riser conduit anchoring plan / drawing
4. Conduit chase plan / drawing
5. Communication pathway plan / drawing
6. Junction box, gutter and pull box labeling plan / drawing
7. Cabinet / rack elevation drawing
8. Floor plan drawing for all ER / TR rooms
9. Wall elevation drawings for all ER / TR rooms

K. All submittals for substitutions or modifications shall be made to the ITNO for approval prior to start of work.

1.5 QUALITY ASSURANCE

A. Verification: The Owner shall maintain inspection personnel on the job site. It is incumbent upon the Contractor to verify that the installation and material used has been inspected before it is enclosed within building features, or otherwise hidden from view. The contractor shall bear costs associated with uncovering or exposing installations or features that have not been inspected.

B. Equipment: The Contractor is to use equipment and rigs designed for pulling, placement and termination of multi-pair copper cable; including reel trucks, mechanical mules, sheaves, shoes, anchors etc., and equipment for drilling masonry, installing anchors, etc., to install support and cable management hardware.
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PART 2 - PRODUCTS

2.1 COPPER CABLE

A. Substitutions for products specified are not permitted without express written approval of Information Technology Network Operations.

B. Solid Copper Backbone/Tie Copper Cable: 24 AWG, UTP, Category 3, OSP Backbone Cables with an overall metallic shield. Manufacturer: Berk-Tek - Part Number: 10032113

C. Voice backbone cables installed in underground conduits or the tunnel shall be gel-filled PIC cable to a termination point within the ER. The backbone cable shall then be cross-connected to the protector blocks.

D. All splice cases used in the multi pair voice backbone shall be waterproof.

E. Building entrance protection for copper cabling shall be installed utilizing a two (2) foot fuse link between outside plant cable plant splice and the protector module with IDC-type input and output terminals, 100 pair-pair capacity and female mounting base, equipped with 230 volt solid state protector modules. Sufficient protector modules shall be provided to completely populate all building entrance terminals.

F. The shield of all inter-building backbone cables must be bonded to the ground lug on the primary protector panel. The protector panel must be bonded to the Telecommunications Main Grounding Busbar. The shield of all intra-building backbone cables must be bonded to the Telecommunications Main Grounding Busbar.

G. Voice backbone cables shall have a minimum 10-foot service loop when terminated in the MDF/IDF, and at any splice points in telecommunications manholes.

2.2 PROTECTOR PANELS

A. Entrance Terminals - CIRCA 188OECA1-100G

B. Protector Modules – CIRCA Gas Protector Unit – 3BIE

2.3 COPPER TERMINATION HARDWARE

A. Main Cross Connect (MC)
   1. 5 Pair – Panduit P110KB1005
   2. 5 Pair – CommScope UNK-110-WB-5M-100PR
   3. 4 Pair – Panduit P110KB1004
   4. 4 Pair – CommScope UNK-110-WB-4M-100PR

B. Entrance Facility (EF)
   1. 5 Pair – Panduit P110KB1005
   2. 5 Pair – CommScope UNK-110-WB-5M-100PR
   3. 4 Pair – Panduit P110KB1004
   4. 4 Pair – CommScope UNK-110-WB-4M-100PR

C. 24 Port Angled Patch Panels, filled and terminated with appropriate number of black RJ-45 jacks.
   1. Panduit – UICMPPA24BL
   2. CommScope – M2000A-24

D. Copper Backbone Rack Termination: 8-pin modular Category 3, un-keyed, a single pair terminated on each jack on pins 4 and 5. Installed in the 24 port angled patch panel:
   1. Panduit White CJ88WHY
   2. CommScope White M1BH-H-262

2.4 OUTSIDE PLANT FIBER OPTIC CABLE

A. 12-strand 9/125 micron single-mode outside plant rated fiber optic cable: CommScope

B. All fiber optic cable with loose tube construction installed underground shall be gel filled or be constructed of appropriate waterproofing compounds.

C. No splicing is allowed in fiber optic cables between buildings.

D. All newly installed fiber optic cable shall be placed inside fiber optic innerduct when not in conduit or utility tunnel cable tray. A pull string must be run in addition to the cable in order to provide access for future growth.

E. Fiber optic cables shall always have minimum 20-foot service loop at the terminating ends and all approved splice points. Place service loops with large bend radii neatly bundled on walls or on the attached to the bottom side of ladder trays in ‘figure-8’ configuration.

2.5 INSIDE PLANT FIBER OPTIC CABLE

A. 12-strands Plenum-rated 9/125 micron Singlemode fiber optic cable: Manufacturer - CommScope

2.6 FIBER TERMINATION HARDWARE

A. Rack-mounted Fiber Distribution Units for MDF: CommScope #RFE-FXD-EMT-BK/4U

B. Rack-mounted Fiber Distribution Units for IDF: CommScope #RFE-SLG-EMT/2U

C. LC fiber connectors

2.7 FIBER PATCH CABLES

A. Fiber Optic Patch Cords with LC connectors for SM Cable: Panduit
   1. Yellow for single-mode

B. One duplex patch cable for every fiber optic strand terminated.

B. Patch cables to be of like type and connector to fiber cable.

C. Length shall be adequate to reach owner provided electronic equipment mounted in lower section of relay rack.

PART 3 – EXECUTION

3.1 CABLE INSTALLATION – OUTSIDE PLANT

A. Splicing of fiber optic cable is not allowed between buildings.

B. All fiber shall be installed in innerduct. Innerduct shall be spliced according to manufacturer approved methods.

C. At a minimum, 12 -strand, single-mode fiber of size 9/125 micron shall be installed. Single-mode fiber size shall be 9/125 micron.

D. The average/maximum fiber splice loss for single-mode fusion splices shall be 0.05/0.3 dB.

E. Contractor shall submit the cable pulling plan to the Owner prior to commencement of the operation.

F. All inner-duct shall be spliced according to manufacturer approved methods.

G. The route of multi-pair copper cable installation is as described herein or as shown on the Drawings.

H. The Contractor shall ensure the cables are pulled into the ducts in a manner observing the bend radii and tension restrictions of the cable.

I. The Contractor shall use appropriate shoes, guides, wheels and lubricants to prevent damage to the cable jacket and sheath during installation.

J. Install shield bond connectors to the shields of all cables terminated at the Protector Panels.

K. The Contractor shall apply an appropriate amount of damming compound over the end of filled copper cables in indoor or dry environments to prevent seepage of cable filling compounds where encapsulant shall not be used.

L. Prior to closure assembly in dry or indoor installations, all exposed cable pairs shall have the filling compound thoroughly cleaned off the cable insulation using appropriate cleaning solvents.

M. All pairs spliced shall be tested and all splice-related faults cleared prior to sealing the closure assembly.

3.2 BACKBONE CABLE TESTING

A. Complete end-to-end test results for all copper UTP and fiber optic lines installed is required.

B. All multi-pair copper cable pairs installed shall be tested to TIA/EIA 568A, Category 3 or Category 6 equivalent performance specifications. In addition, provide loop resistance measurements in ohms and dB loss at 1KHz, 8KHz, and 256KHz.

C. The Owner is to be notified at least 24 hours prior to testing to allow observation at the Owner's discretion. If the Owner confirms his intention to observe, a reasonable starting time shall be agreed upon. Should the Owner not be present at the scheduled commencement time, the Contractor may begin testing as scheduled.

D. Optical Fiber Cable Testing w/ Optical Time Domain Reflectometer (OTDR) and Optical Power Loss Meter

1. Test all lightguide cable prior to the installation of the cable. Assume liability for the replacement of the cable should it be found defective at a later date.
2. All fiber testing shall be performed on all fibers in the completed end-to-end system. Testing shall consist of a bi-directional end-to-end for Optical Power loss meter measurement. The system loss measurements shall be provided at 1310 and 1550 for single mode fibers.
3. Any link not meeting the requirements of the standard shall be brought into compliance by the contractor, at no charge to the Galveston County.
4. Reference power measurement (when not using a power meter with a Relative Power Measurement Mode).
5. Measured attenuation of the link segment.
6. Acceptable link attenuation.
7. Acceptable test values shall meet the requirements of ANSI/EIA/TIA-526-7

E. 100% of all pairs in backbone copper cables shall be tested for continuity and wire-map.

F. Format: Test Results must be submitted in two (2) formats. First, must be original file(s) down loaded from tester. Second, the file must be cohesively placed in PDF.

G. Care, with reference to above format criteria, should be taken when recording the information in the tester, proper consistency with port identification is required.

H. As- Built drawings must be submitted with .dgn or .dwg file extensions.

I. Delivery: Test Results may be electronically submitted. Contact information shall be provided after contract is awarded and before project completion

J. All test results are to be recorded and turned over to the Owner for checking.

3.2 CABLE AND TERMINATION PANEL LABELING

A. Label the installed cables in accordance with Section 27 05 53

3.3 CABLE SUPPORT

A. Provide cable supports and clamps to attach cables to backboards and walls.
1. Attach horizontal and vertical backbone cables at 2 foot intervals using Owner approved supports; such as D-rings or jumper troughs utilized for wire management.

B. Attach cables to manhole racks using Owner approved methods

3.3 AS-BUILT DRAWINGS

A. Provide three (3) copies of E and three (3) copies of C size prints along with CADD files in .dwg or .dgn formats showing floor plans with room numbers and actual backbone cabling and pathway locations and labeling. The deliverable is required within 5 business days of final cable testing.

B. Red Line Drawings: Contract must kept one (1) E size set of floor plans on site during work hours with installation progress marked and backbone cable labels noted. Contractor may be asked to produce these drawings for examination during construction meetings or field inspections.

END OF SECTION

SECTION 27 15 00
COMMUNICATIONS HORIZONTAL CABLING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Horizontal communications cabling materials and installation methods

B. Copper connectivity equipment.

C. Horizontal cable testing methods.

1.2 RELATED DOCUMENTS

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

B. Related Division 27 Sections include:
   1. 27 05 00 Common Work Results for Communications

1.3 SUMMARY

A. This Section specifies the requirements for Communications Horizontal Cabling for the Galveston County Road and Bridge Facility.

B. All voice and data horizontal cables shall consist of plenum-rated, solid copper, 24 AWG, 100 balanced twisted-pair (UTP) Category 6 cables with four individually twisted-pairs, which meet or exceed the mechanical and transmission performance specifications in ANSI/TIA/EIA-568B.2.

C. Horizontal cabling shall be terminated in the MDF on 48-port, 8-pin modular insulation displacement connector (IDC) meeting Category 6 performance standards and pinned to TIA 568B standards. Category 6 patch panels shall be mounted in an approved 19-inch relay rack. 100 percent of the horizontal cabling shall be terminated on patch panels in the telecommunications room.

D. The maximum horizontal distance shall be 295 feet.

E. All information outlets will be flush type mounted into conduits and boxes. Typical outlets will be used in the offices and consist of two voice and two data cables with 568B outlet configurations.

F. Each horizontal cable must be tested with documentation provided.

G. Contractor shall keep updated redline drawings and provide as-built documentation in both print and electronic formats.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Plenum Rated UTP Category 6 Cable
   1. General Cable - 7131900 – Cable Jacket Color shall be Blue.

B. Angled Patch Panels
   1. Panduit – UICMPPA48BL

C. Faceplates
   1. Panduit – CFPE4IW

D. Telecommunication Outlets: 8-pin modular Category 6, un-keyed, pinned T568B standards to be fully terminated. Single gang mounting plate with four (4) openings which shall include one or more of the following devices:

1. Panduit
   a. Telecommunications Outlet – Color:Blue – CJ688 TP BU

PART 3 - EXECUTION

3.1 GENERAL

A. Follow manufacturer's installation guidelines and Galveston County Information Technology Telecommunication Infrastructure Standards.

B. All voice and data cabling and terminations and termination hardware shall be TIA/EIA wiring configuration T568B.

C. All voice and data cabling shall be continuous from the nearest telecommunications room to the telecommunications outlet. Splicing of cable is not allowed.

D. The length of each individual run of horizontal cable from the administration subsystem (Telecommunications Room) to the Telecommunication Outlet shall not exceed 295 ft.

E. The 4 pair UTP cable shall be Underwriter's Laboratories (UL) listed type CMP.

F. Strict attention shall be paid to the manufacturer's guidelines on bend radii and maximum pulling tension during installation. Notice that the recommended minimum bend radius for a cable during installation is typically greater than the recommended bend radius after the cable is installed. This is to minimize tension and deformation as the cables pass around corners during installation. The maximum pull-force guideline for 4-pair horizontal balanced twisted pair cables is 110 N (25 lbf).

G. UTP Cabling:
   1. Provide a minimum of 3-foot service loop (for re-termination) for horizontal cables. Locate service loop where horizontal cable run transitions to cable tray. Place at least 6” of service loop in outlet box.
   2. The horizontal distance is the cable length from the mechanical termination of the media at the horizontal cross-connect in the telecommunications room to the telecommunications outlet/connector in the work area. The maximum horizontal distance shall be 295 ft, independent of media type. The length of the cross-connect jumpers and patch cords in the cross-connect facilities, including horizontal cross-connects, jumpers, and patch cords that connect horizontal cabling with equipment or backbone cabling, should not exceed 5 m (16 ft) in length. For each horizontal channel, the total length allowed for cords in the work area plus patch cords or jumpers plus equipment cables or cords in the telecommunications room shall not exceed 10 m (33 ft).
   3. Cable and components shall be visually inspected for proper installation. Cable stress, such as that caused by tension in suspended cable runs and tightly cinched bundles, shall be minimized. Plenum rated Velcro ties used to bundle cables should be applied loosely to allow the Velcro tie to slide around the cable bundle. The vector ties should not be cinched so tightly as to deform the cable sheath. Cable placement should not deform the cable sheath.
   4. Minimum bend radius: The minimum bend radius for cable will vary depending on the condition of the cable during installation (tensile load) and after installation when the cable is at rest (no-load).
   5. The minimum bend radius, under no-load conditions, for 4-pair unshielded twisted-pair (UTP) cable shall be four times the cable diameter.
   6. Copper cable splicing or bridge tapping is unacceptable.
   7. Cables should be terminated with connecting hardware of the same category or higher. To maintain the cable geometry, remove the cable sheath only as much as necessary to terminate the cable pairs on the connecting hardware. The connecting hardware manufacturer's instructions for cable sheath strip-back shall be followed. When terminating

Category 6 and higher cables, the cable pair twists shall be maintained to within 13 mm (0.5 in) from the point of termination. For best performance when terminating cable on connecting hardware, the cable pair twists should be maintained as close as possible to the point of termination.

8. The Cable Contractor shall install 4-pair Category 6 plenum rated UTP cables from the appropriate telecommunication room to each outlet location as indicated on the telecommunications drawings.

3.2 SITE QUALITY CONTROL

A. Site Testing and Inspection Agency Qualifications

1. Every cabling link in the installation shall be tested in accordance with the field test specifications defined in ANSI/TIA/EIA-568-B.2-1 “Transmission Performance Specifications for 4-pair, 100 Ohm, Category 6 Cabling”. This document will be referred to as the “TIA Cat 6 Standard.”
2. The installed twisted-pair horizontal links shall be tested from the patch panel in the telecommunications room to the telecommunication wall outlet in the work area against the “Permanent Link” performance limits specification as defined in the TIA CAT 6 Standard.
3. Trained technicians who have successfully attended an appropriate training program and have obtained a certificate as proof thereof shall execute the tests. Appropriate training programs include but are not limited to installation certification programs provided by BICSI or the ACP (Association of Cabling Professionals).
4. The test equipment shall comply with the accuracy requirements for level III field testers as defined in ANSI/TIA/EIA 568B.2-1. The tester including the appropriate interface adapter must meet the specified accuracy requirements. The accuracy requirements for the permanent link test configuration (baseline accuracy plus adapter contribution) are specified in Table B.2 of Annex B of in ANSI/TIA/EIA 568B.2-1. (Table B.3 in this TIA document specifies the accuracy requirements for the Channel configuration.)
5. The test plug shall fall within the values specified in E.3.2.2 Modular test plug NEXT loss requirements of the in ANSI/TIA/EIA 568B.2-1.
6. The tester shall be within the calibration period recommended by the vendor in order to achieve the vendor-specified measurement accuracy.
7. The tester interface adapters must be of high quality and the cable shall not show any twisting or kinking resulting from coiling and storing of the tester interface adapters. In order to deliver optimum accuracy, preference is given to a permanent link interface adapter for the tester that can be calibrated to extend the reference plane of the Return Loss measurement to the permanent link interface. The Cable Contractor shall provide proof that the interface has been calibrated within the period recommended by the vendor. To ensure that normal handling on the job does not cause measurable Return Loss change, the adapter cord cable shall not be of twisted-pair construction.
8. One hundred percent of the installed cabling links must be tested and must pass the requirements of the standards in this section. Any failing link must be diagnosed and corrected. The corrective action shall be followed with a new test to prove that the corrected link meets the performance requirements. The final and passing result of the tests for all links shall be provided in the test results documentation in accordance with the Test Result Documentation as listed below.

B. Site Testing, Inspection and Acceptance

1. The Pass or Fail condition for the link-under-test is determined by the results of the required individual tests. Any Fail or Fail* result yields a Fail for the link-under-test. In order to achieve an overall Pass condition, the results for each individual test parameter must Pass or Pass*.
2. A Pass or Fail result for each parameter is determined by comparing the measured values with the specified test limits for that parameter. The test result of a parameter shall be marked with an asterisk (*) when the result is closer to the test limit than the accuracy of the field tester. The field tester manufacturer must provide documentation as an aid to interpret results marked with asterisks.

3. A representative of the design team shall be invited to witness field testing. The representative shall be notified of the start date of the testing phase five business days before testing commences.
4. At the conclusion of field testing, at a time scheduled by the owner's representative, the owner's representative will select a random sample (up to 10%) of the installed links in each wiring closet. The Cable Contractor, under supervision of the owner's representative, shall test these randomly selected links and the results are to be stored in accordance with the prescriptions in Test Result Documentation as listed below.
5. The results obtained shall be compared to the data originally provided by the Cable Contractor. If any (one or more) of the sample test reports displays a fail or fail* result, the Cable Contractor shall resolve any conditions causing the failed test and under supervision of the owner’s representative shall repeat 100% of the testing and the cost shall be borne by the Cable Contractor.

C. Performance Test Parameters
1. The test parameters for CAT 6 are defined in TIA CAT 6 standard, which refers to the ANSI/TIA/EIA-568-B.2 standard. The test of each link shall contain all of the following parameters as detailed below. In order to pass the test all measurements (at each frequency in the range from 1 MHz through 250 MHz) must meet or exceed the limit value determined in the above-mentioned standard.
   a. Wire Map
   b. Length
   c. Insertion Loss (Attenuation)
   d. NEXT Loss
   e. PSNEXT Loss
   f. ELFEXT Loss, pair-to-pair
   g. PSELFEXT Loss
   h. Return Loss
   i. ACR (Attenuation to crosstalk ratio)
   j. PSACR
   k. Propagation Delay
   l. Delay Skew [as defined in TIA/EIA-568-B.1; Section 11.2.4.11]

D. Test Result Documentation
1. The test results information for each link shall be recorded in the memory of the field tester upon completion of the test.
2. The test results records saved by the tester shall be transferred into a Windows™-based database utility that allows for the maintenance, inspection and archiving of these test records. A guarantee must be made that the measurement results are transferred to the PC unaltered, i.e., “as saved in the tester” at the end of each test and that these results cannot be modified at a later time. Superior protection in this regard is offered by testers that transfer the numeric measurement data from the tester to the PC in a non-printable format.
3. The database for the completed job shall be stored and delivered electronically including the software tools required to view, inspect, and print any selection of test reports.
4. A PDF copy of the test results shall be provided that lists all the links that have been tested with the following summary information:
   a. The identification of the link in accordance with the naming convention defined in the overall system documentation.
   b. The overall Pass/Fail evaluation of the link-under-test including the NEXT Headroom (overall worst case) number.
   c. The date and time the test results were saved in the memory of the tester.
5. General Information to be provided in the electronic data base with the test results information for each link:
   a. The identification of the customer site as specified by the end-user.
   b. The identification of the link in accordance with the naming convention defined in the overall system documentation.

c. The overall Pass/Fail evaluation of the link-under-test.
d. The name of the standard selected to execute the stored test results.
e. The cable type and the value of NVP used for length calculations.
f. The date and time the test results were saved in the memory of the tester.
g. The brand name, model and serial number of the tester.
h. The identification of the tester interface.
i. The revision of the tester software and the revision of the test standards database in the tester.
j. The test results information must contain information on each of the required test parameters.

6. The detailed test results data to be provided in the electronic database for each tested link must contain the following information:
   a. For each of the frequency-dependent test parameters, the value measured at every frequency during the test is stored. In this case, the PC-resident database program must be able to process the stored results to display and print a color graph of the measured parameters. The PC-resident software must also provide a summary numeric format in which some critical information is provided numerically as defined by the summary results (minimum numeric test results documentation) as outlined above for each of the test parameters.
      1) Length: Identify the wire-pair with the shortest electrical length, the value of the length rounded to the nearest 0.1 m (1ft) and the test limit value.
      2) Propagation delay: Identify the pair with the shortest propagation delay, the value measured in nanoseconds (ns) and the test limit value.
      3) Delay Skew: Identify the pair with the largest value for delay skew, the value calculated in nanoseconds (ns) and the test limit value.
      4) Attenuation: Minimum test results for the worst pair.
      5) Return Loss: Minimum test results for the worst pair as measured from each end of the link.
      6) NEXT, ELFEXT, ACR: Minimum test results documentation as explained in Section I.B for the worst pair combination as measured from each end of the link.
      7) PSNEXT, PSELFEXT, and PSACR: Minimum test results documentation for the worst pair as measured from each end of the link.

E. As-built drawings
   1. Provide CAD files in .dwg or. dgn formats showing floor plans with room numbers and actual outlet locations and labeling. The deliverable is required within 5 business days of final cable testing.
   2. Red Line Drawings: Contract must keep one (1) E size set of floor plans on site during work hours with installation progress marked and outlet labels noted. Contractor may be asked to produce these drawings for examination during construction meetings or field inspections.

END OF SECTION 27 15 00

SECTION 27 20 00
DATA COMMUNICATIONS EQUIPMENT

PART 1 – GENERAL

1.1 SECTION INCLUDES

A. Data Communications Equipment.

1.2 RELATED DOCUMENTS

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

B. Related Division 27 Sections include:
   1. 27 05 00 Common Work Results for Communications

1.3 SUMMARY

A. This Section specifies the requirements for the Data Communications Equipment for the Galveston County Road and Bridge Facility

B. Data Communications Equipment
   1. Data Communications Equipment includes customer owned routers, servers, Ethernet switches, personal computers, printers, wireless access points, etc. required to connect the Academic Wing to the rest of the campus, the internet and the public switched telephone network (PSTN).
   2. Data Communications Equipment will be Owner Furnished Owner Installed (OFOI).
   3. Cable Contractor shall fully cooperate and coordinate with Owner as required to ensure proper integration and connectivity between systems.

PART 2 - PRODUCTS (NOT APPLICABLE)

PART 3 - EXECUTION

3.1 COORDINATION

A. Cable Contractor shall fully cooperate and coordinate with Owner as required to ensure proper integration and connectivity between systems.

B. Cable Contractor shall furnish labeled floor plan and excel run sheet to Owner two weeks prior to occupancy.

C. Cable Contractor shall furnish and install all patch cords in conjunction with Owner.

E. Cable Contractor shall provide adequate technician support first business day after data equipment installation and connectivity.

END OF SECTION

SECTION 27 30 00
VOICE COMMUNICATIONS EQUIPMENT

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.

B. Related Division 27 Sections include:
   1. 27 05 00 Common Work Results for Communications

C. Galveston County Information Technology Telecommunication Infrastructure Standards

1.2 SUMMARY

A. This Section specifies the requirements for the Voice Communications Equipment for the Galveston County Road and Bridge Facility.

B. Voice Communications Equipment
   1. Voice Communications Equipment includes customer owned phones, faxes, etc. required to connect the Galveston County Road and Bridge Facility to the rest of the campus and the public switched telephone network (PSTN).
   2. Voice Communications Equipment at Galveston County Road and Bridge is provided by Owner.
   3. Voice Communications Equipment will be Owner Furnished Owner Installed (OFOI).

PART 2 - PRODUCTS (NOT APPLICABLE)

PART 3 - EXECUTION

3.1 Coordination

A. Cable Contractor shall fully coordinate with Owner's Voice Communications Equipment provider as required to ensure proper integration and connectivity between systems.

B. Cable Contractor shall furnish labeled floor plan and excel run sheet to Owner's Voice Communications Equipment provider two weeks prior to occupancy.

C. Cable Contractor shall furnish and install all patch cords in conjunction with Owner's Voice Communications Equipment provider.

E. Cable Contractor shall provide adequate technician support first business day after Voice equipment installation and connectivity.

END OF SECTION 27 30 00

SECTION 27 40 00
AUDIOVISUAL 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: furnishing, installing, testing and documenting audiovisual systems for the Galveston County Road and Bridge Facility.

B. Audiovisual Systems shall consist of multiple systems with various configurations per the AV Room Type Device Schedules and the design specifications and drawings.

C. These systems include some or all of the following:
1. Wall mounted, ceiling mounted, and ceiling hung speaker systems.
2. Mounting of flat screen video displays and projectors.
3. Audio input/output panels, microphones, wireless microphone systems, mixers, switchers, audio processors and amplifiers.
4. Video input/output panels, PTZ cameras, Blu-ray players, switchers and scalers.
5. Video conferencing codecs, microphones, cameras, mounts and cables.
6. Programmable audiovisual remote and automated control system and associated support devices for controlling audio and video systems, etc.
7. Floor, wall and desktop connection hubs for audio, video, broadband, LAN, remote control signaling, computer and pull junction boxes.
8. Wiring and connectors.

D. Room Type Functional Narrative:

1. Digital Signage: This system shall provide digital signage/messaging at locations identified on plans.

   Video System:
   - Wall mounted flat panel displays rated for commercial use.
   - Digital signage media player.
   - Content creation and management shall be by the Owner.

2. Conference Room: This system will provide local, ad-hoc meeting support for small groups. Content sharing shall be provided by a wireless presentation gateway (WPG) or wired HDMI input at the table.

   Video System:
   - Wall mounted flat panel display rated for commercial use.
   - Wireless presentation gateway.
   - HDMI input at the table

   Audio System:
   - Display's internal speakers.

Control System:

- Display on/off shall be via the display internal timer and be set to the facilities operating hours.
- Source selection shall be automatic with the WPG as the default and switching to the wired HDMI upon signal presence.

3. Collaboration Room: This system will provide a meeting space for small to medium groups. Local meetings, web-video conferencing, and VoIP audio conferencing shall be supported. Content sharing shall be provided by a wall mounted HDMI plate, a wireless presentation gateway (WPG) and a local computer (OFCI). USB camera video and room audio shall be connected to the local PC for web-conferencing. A partition sensor shall automatically engage the speakers and microphone on the overflow side of the room when the partition is open.

   Video System:
   - Wall mounted flat panel display rated for commercial use.
   - HDMI input plate at the table.
   - Wireless presentation gateway.
   - Local computer (OFCI)

   Audio System:
   - Ceiling recessed loudspeakers.
   - Ceiling mounted microphones.
   - Audio Digital Signal Processor (DSP) with USB and VoIP.

   Control System:
   - AV system room controls shall be provided by wall mounted touch-screen control panel. System power on/off, source selection, volume control, PTZ camera control and VoIP call controls shall be provided.

1.03 OVERVIEW

A. The work detailed by these specifications and drawings has been specified to meet certain requirements for performance. Some information, such as exact equipment models, layout, wire routing, additional conduit and power requirements, etc. has been omitted. It shall be the responsibility of the Contractor to translate these specifications and drawings into a complete design package containing all necessary elements for a complete turnkey installation including all material, labor, warranties, shipping and permits.

B. General elements of the work shall consist of but not limited to:
   1. Procure all permits and license required to complete this installation.
   2. Attend pre-construction/pre-submittal meeting with Owner and Consultant to review design package for the Audiovisual Systems.
   3. Prepare schedule of work.
   4. Submittal preparation and processing prior to ordering equipment.
   5. Attend submittal review meeting.
   6. Provide materials necessary to complete the Audiovisual Systems.
   7. Perform camera pre-installation sign-off walk through with Owner and Consultant.
   8. Installation of cameras and camera cabling.
   9. Provide all required software and licenses to the Owner.
   10. Contractor shall provide continuous on-site supervision of the installation technicians. On-site supervision shall include: daily supervision of the work, updating work site progress drawings to reflect changes and installations details, preparing weekly progress

reports and attendance at site coordination meetings as directed by the Owner and Consultant.

11. The Contractor shall provide all miscellaneous hardware including cable management devices, termination cabinets, wire and cable labeling materials, fasteners, hangers and brackets as required.
12. The contractor shall provide all materials, equipment, labor and all other incidental material, tools, appliances and transportation as required for a complete and functional audio video system (AVS) as described herein and supplementary drawings.
13. Coordination with all trades and Owner representatives as required facilitating the installation of the control system equipment including: Door Hardware, Fire Alarm, Blinds, Shades, HVAC and Electrical Divisions.
14. Coordinate receipt of Owner furnished equipment.
15. Perform installation according to contract documents and manufacturers recommendations.
16. Protect new facilities finishes and equipment.
17. Maintain construction materials and refuse within the area of work.
18. Clean the work area at the end of each day.
19. Provide system software and programming and other materials necessary for the Audiovisual Systems to function by standard industry practices.
20. Program Audiovisual Systems and load with user define text and specified operations per design specifications and drawings.
21. Provide browser-based control interface for all programmed interfaces and room systems.
22. All touch panel and internet controls must have “User interface” (Basic functionality) and Lock able / password “Admin user interface” (Advance functionality). Coordinate all programming with Owner and Consultant for approval.
23. Provide network control and maintenance information of all rooms via enterprise level management solution.
24. Providing (1) final programming change for all systems after 3-months of Owner use, post substantial completion.
25. Perform initial testing, programming and adjustments with written reports.
26. Make final adjustments, calibrations and programming modifications as directed by the Owner and Consultant.
27. Demonstrate all systems for final acceptance.
28. Preparation of O&M manuals and as-built documents for Owner’s use.
29. Providing training for Owner’s staff, facility personnel and technical staff.
30. Providing warranty service for a period of one year from acceptance date.
31. Provide extended system support options.

1.04 DEFINITIONS

A. AVS: Audiovisual System.

B. OWNER: Galveston County

C. CFCI: Contractor Furnished Contractor Installed

D. OFOI: Owner Furnished Owner Installed.

E. OFCI: Owner Furnished Contractor Installed.

F. CONTRACTOR: Contractor or subcontractor providing and installing the Audiovisual System.

G. PROJECT: Road and Bridge Facility

H. PROVIDE: Furnish, install, commission, test and warrant.

I. WORK: Action required furnishing, installing, commissioning, testing and warranting the Audiovisual Systems.

J. COMPONENT: Any individual item of equipment or material which is an element of the Audiovisual Infrastructure System is.

K. ZONE: Separate parallel signal path with independent processing and alternate program capabilities.

L. AGC: Automatic gain control.

M. DSP: Digital signal processor.

N. CCD: Charge-coupled device.

O. CTS: Certified Technology Specialist.

P. MPEG: Moving picture experts group.

Q. NTSC: National Television System Committee.

R. UPS: Uninterruptible power supply.

S. POE: Power over Ethernet.

1.05 PERFORMANCE REQUIREMENTS

A. These specialized AVS systems are designed to efficiently support the Owner's various facilities and activity areas in a manner, which can be proficiently managed by the staff. Work shall include the complete turnkey installation and commissioning of these systems per the following specifications and drawings.

1.06 SUBMITTALS

A. Contractor's on-site CTS-D supervisor shall review, approve and sign off all submittal documents.

B. Provide documentation as outlined in quality assurance. Submit all supervisor and installation team members' resumes and manufacturer certification certificates.

C. Product Data:
1. Provide index list of all system components including manufacturer and model number. Index list shall be arranged alphabetically by manufacturer then model number.
2. Manufacturer's literature sheets for all materials and equipment, including warranty information, recommended preventative maintenance and spare part inventory recommendations. Literature containing more than one device shall be clearly marked to delineate item(s) included in the Work. Literature shall be ordered to match the index list.
3. Clearly indicate color or special finishes.
4. Correlate products with 274000 Specification and use in Project.

D. Pricing Forms: Contractor shall submit completed pricing form that includes an itemized listing of all equipment, materials and labor required for the installation of the system as specified herein for bid response consistency and change order pricing. The listing shall contain: item description, item model number, quantity, unit cost and extended labor, material and installation cost required to provide a complete and functional system for each room type.

E. The following format must be used for bid response packages. Products and pricing are for illustration purposes only and are not specific to this project.

CONFERENCE ROOM (TYPICAL OF ROOM #s 123, 220, 350)

QTY	MAKE	MODEL	DESCRIPTION	PRICE EACH	EXTENDED
1	Crestron	DMPS3-4K-50	Presentation switcher	$3,000.00	$3,000.00
4	JBL	Control 47LP	70V recessed ceiling speaker	$239.00	$956.00
1	LG	65LX540S	65” flat screen display	$1,817.00	$1,817.00
				ROOM EQUIPMENT SUBTOTAL	$5,773.00
	Labor (Include field labor, management, programming)				$570.00
1	Cabling, Connections and Hardware			$250.00	$250.00
				LABOR/INSTALLATION SUBTOTAL	$820.00
				TOTAL PER ROOM	**$6,593.00**

HUDDLE ROOM (TYPICAL OF ROOM #s 250,410)

QTY	MAKE	MODEL	DESCRIPTION	PRICE EACH	EXTENDED
1	Extron	DTP T USW 233	Three input switcher	$1,390.00	$1,390.00
1	Extron	DTP HDMI 4K 230 D RX	AV receiver	$690.00	$690.00
1	LG	49LW540S	49” flat screen display	$700.00	$700.00
				ROOM EQUIPMENT SUBTOTAL	$2,780.00
	Labor (Include field labor, management, programming)				$380.00
1	Cabling, Connections and Hardware			$150.00	$150.00
				LABOR/INSTALLATION SUBTOTAL	$530.00
				TOTAL PER ROOM	**$3,310.00**

JOB SUMMARY

QTY	ROOM TYPE	EQUIPMENT	LABOR/INSTALLATION	COST PER ROOM	ROOM TYPE TOTAL
3	CONFERENCE ROOM	$5,773.00	$820.00	$6,593.00	$19,779.00

2	HUDDLE ROOM	$2,780.00	$530.00	$3,310.00	$6,620.00
	SUBTOTALS	$22,879	$3,520.00		
				BID TOTAL	**$26,399.00**

LABOR RATES

LABOR TYPE	**HOURLY RATE**
Project Manager	$50.00
Programmer	$50.00
Engineer	$50.00
Site Supervisor	$50.00
Installer	$50.00

F. Programming:
1. Provide and coordinate with the Owner any and all possible control functionalities based on project drawing and specifications.
2. Provide browser-based control interface for all programmed interfaces and room systems.
3. Provide screen shots / templates and a narrative description of all “User Interfaces” and “Admin Interfaces” functionality. Contractor must have written approval of control lay-out and functionality prior to installation of programming.
4. Provide Owner with a full functioning control system.
5. Owner may use AV control system up to 3 months after substantial completion. After which the Contractor must provide the Owner (1) final programming change to any and all AV control systems. But not limited to:
   a. Touch Panels
   b. Key Pads
   c. Functionality
   d. Control
   e. Added equipment

G. Shop Drawings:
1. Contractor’s on-site CTS-D supervisor shall review, approve and sign off all shop drawings, coordination drawings, and as-built drawings documents.
2. Reproducing Contract Documents for shop drawing is not acceptable.
3. Shop drawings to include the following:
   a. Drawing legend sheet describing all symbols used on the drawings.
   b. Floor plans with all devices and wiring raceway depicted.
   c. Wire runs with tags for type, gauge, quantities and cable identifiers.
   d. System riser diagram indicating all field devices, riser paths and room designations.
   e. Block diagram for each system showing all equipment and signal pathways.
   f. Point schedules defining interconnection of all inputs and outputs for all equipment including data connections and other systems with cable identifiers.
   g. Elevations of equipment racks and teaching consoles.

h. Fabrication shop drawings for all custom components.
i. Diagrams for power, signal, control wiring and grounding.
j. Include plans, elevations, sections, details, and attachments to other work.

H. Coordination Drawings: Reflected ceiling plans, drawn to scale, with ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings are shown and coordinated, using input from installers of the items involved. Provide similar elevation drawings for wall-mounted items.

I. Samples: Provide as requested for colors and texture coordination.

J. Partial submittals shall not be acceptable without prior approval.

K. No portion of the work shall commence, or equipment ordered until the Owner has approved the submittals.

L. The Contractor shall not be relieved from any contract-required responsibility by the Owner's approval of submittals.

M. Nothing in the specification shall relieve Contractor of system package design responsibility, including, but not limited to, all equipment furnished under this Contract. The Contractor is, in all cases, solely responsible for the performance of the delivered AVS, and for furnishing complete system documentation for each and every part of the system.

N. Extended AVS Support.
1. Provide pricing for AVS hardware and software support including necessary reconfiguration and data base changes for years 2 through 5.

O. Resubmitting.
1. Make corrections or changes in Submittals as required by the Consultant’s stamp instructions and attached comments and resubmit.
2. Identify changes on resubmittals by clouding. Only indicated changes will be reviewed when resubmitted.
3. Added drawings shall be clearly identified.
4. Contractor shall be responsible for project delays caused by rejected submittals.
5. Consultant shall be compensated for additional services for submittals rejected more than twice. The amount of such compensation shall be incorporated by change order and withheld from the Contractor‘s Application for Payment.

1.07 QUALITY ASSURANCE

A. Installer Qualifications:
1. The Contractor performing the installation shall have a minimum of 5 years experience in the installation of AVS systems of similar size and scope.
2. An AVIXA CTS shall supervise and approve all on-site work as a recognized member of the Contractor’s installation team. All installation team members must demonstrate knowledge and compliance with all AVIXA, TIA, UL, and NEC methods, standards and codes. Submit resumes of the entire team and completed training courses and certifications.
3. All members of the installation team must be certified by the Manufacturer as having completed the necessary training to complete their part of the installation.
4. Owner's representative may make such investigations as deemed necessary to determine that the Contractor is responsive, responsible and qualified in the area of work contemplated by the Contract. In this regard, the Contractor shall furnish to the Owner

such information as requested for this purpose. Information and data may include (but not necessarily be limited to): Date of organization and/or incorporation and number of years engaged in this business under present firm's names; list of major equipment owned by the company; list of principal personnel who will be involved in the execution of this contract with the experience and qualifications of each person.

5. Contractor shall have local in-house engineering and project management capability consistent with the requirements of this project. The Contractor shall provide a project manager that shall be the same individual throughout the project and shall be the person responsible for system programming, preparation of Operation and Maintenance Manuals, Training, Programs, Schedules and Test Protocols, documentation of system testing, maintenance of record drawings and coordination and scheduling of all labor.
6. Contractor shall be or have direct relations through their subcontractors, an authorized manufacturer's representative for all products they furnish or install.
7. Contractor shall have a local organization capable of providing maintenance and service for the specified system. Facility shall be no more than 100 miles from Owner's site.
8. Contractor shall be capable of providing emergency service on a 24-hour, 7 days a week basis.

B. Conflicts:
1. In the event of any conflicts between documents referenced herein and the contents of this specification, the Contractor shall notify in writing to Consultant of any such occurrences before the purchasing of any equipment, materials and/or installation. The Consultant will notify the Contractor of any actions required to resolve these conflicts. Such actions may include but are not limited to: design changes, equipment, materials and/or installation changes. In any event, Contractor shall not supersede specifications and standards from the latest NFPA and NEC publications.

C. The Contractor shall provide all materials, equipment and installation in compliance with the latest applicable standards from ANSI, ASTM, FCC, IEEE, NCTA, NEC, NEMA, NFPA, REA, TIA/EIA, and UL including but not limited to:
2. American National Standards Institute (ANSI).
3. ANSI T1.404 (DS3) and CATV Applications.
4. American Society for Testing And Materials (ASTM).
5. American with Disabilities Act (ADA).
6. EIA/TIA-569 Standard, Commercial Building Standard for Telecommunications Pathways and Spaces.
7. EIA/TIA-607 Commercial Building Grounding and Bonding Requirements for Telecommunications.
8. National Cable Television Association (NCTA).
9. NCTA-02 NCTA Recommended Practices for Measurements on Cable Television Systems.
10. National Electrical Code (NEC) (Latest revision and pertinent addendums).
11. Article 250, Grounding.
12. Article 300, Part A. Wiring Method.
13. Article 310, Conductors for General Wiring.
14. Article 800, Communication Systems.
15. National Fire Protection Association (NFPA) Publications (Latest revisions and pertinent addendums).
16. Underwriters Laboratories (UL).

D. 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.

E. NECA 1 Good Workmanship in Electrical Contracting.

1.08 PROJECT CONDITIONS

A. Environmental Limitations: System components shall be equipped and rated for the environments where installed.

B. Environmental Conditions.
   1. Capable of withstanding the following environmental conditions without mechanical or electrical damage or degradation of operating capability:
      a. Interior, Controlled Environment: System components installed in conditioned interior environments shall be rated for continuous operation in ambient conditions of 36 to 122 deg F (2 to 50 deg C) dry bulb and 20 to 90 percent relative humidity, non-condensing.
      b. Interior, Uncontrolled Environment: System components installed in non-conditioned interior environments shall be rated for continuous operation in ambient conditions of 0 to 122 deg F (minus 18 to plus 50 deg C) dry bulb and 20 to 90 percent relative humidity, non-condensing.
      c. Exterior Environment: System components installed in locations exposed to weather shall be rated for continuous operation in ambient conditions of minus 30 to plus 122 deg F (minus 34 to plus 50 deg C)] dry bulb and 20 to 90 percent relative humidity, condensing. Rate for continuous operation when 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.

1.09 PROJECT COORDINATION PLAN

A. Contractor shall submit a project plan detailing the steps and associated timeframe to meet the General Contractor's schedule requirements. Project plan should include benchmarks for items such as regular project meetings, equipment order and delivery, installations, configuration and calibrations, testing and burn-in, training, substantial completion notification, testing and final acceptance.

B. Contractor assumes total responsibility for coordinating with building trades or other parties as may be identified by the General Contractor.

C. Coordinate size and location of conduit systems, back boxes, and provisions for electrical power to equipment of this Section.

D. The Contractor must obtain written permission from the General Contractor prior to routing and/or installing cable, equipment or service through the facility.

E. Contractor shall prepare the installation schedule to coordinate sequencing, dependencies and priorities of the system installation including work by other trades.

1.10 COMMISSIONING

A. Commissioning of systems specified in this section is part of the construction process. Documentation and testing of these systems, as well as training of the Owner's operation and maintenance personnel, is required in cooperation with the Owner's Representative and the Commissioning Agent. Project Closeout is dependent on successful completion of all commissioning procedures, documentation, and issue closure.

B. Training of the Owner's operation and maintenance personnel is required in cooperation with the Owner's Representative. Provide competent, factory authorized personnel to provide instruction

to operation and maintenance personnel concerning the location, operation, and troubleshooting of the installed systems. The instruction shall be scheduled in coordination with the Owner's Representative after submission and approval of formal training plans.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

B. Approved manufacturers:

1. Absen
2. AKG
3. AMX
4. Atlas Sound
5. Atlona
6. Audio Technica
7. Audix
8. AVFI
9. Axis
10. Barco
11. Belden
12. Biamp
13. BSS
14. Cable Specialities Inc.
15. Cables to Go
16. CAD
17. Canon
18. Chief Manufacturing
19. Christie
20. Cisco
21. Clock Audio
22. CommScope Properties, LLC.
23. Community
24. Covid
25. Crestron
26. Crown
27. Da-Lite
28. Denon
29. Digital Projection
30. DNP
31. Draper
32. Electro-Voice
33. Elmo
34. Ergotron
35. Extron
36. FSR Inc.
37. Furman
38. Gepco
39. Hitachi
40. Hoffman
41. Hubbell
42. JBL
43. JVC
44. Lab Gruppen
45. Leyard
46. LG
47. Liberty Wire and Cable
48. Listen Technologies
49. Lowell
50. Martin Audio
51. Mersive
52. Middle Atlantic Products
53. NEC
54. Neutrik
55. Panasonic
56. Peerless
57. Pelco
58. Planar
59. Polycom
60. Premier
61. Primeview
62. QSC
63. Radio Design Labs
64. Rane
65. RP Visual
66. Samsung
67. Sennheiser
68. Sharp
69. Shure
70. Sony
71. Sound Control Technologies
72. Spectrum Furniture
73. SurgeX
74. Tannoy
75. Tascam
76. Toshiba
77. Tripp Lite
78. Vaddio
79. wePresent
80. West Penn Wire
81. Williams Sound
82. Wiremold

2.02 AUDIOVISUAL PROGRAMMING AND CONFIGURATION

A. Audiovisual Control System to be composed of BSS components and software. Provide necessary cables, connector and other components a required for the systems to function per the drawings and specifications.

B. Coordinate with Owner to develop basis for control system GUI “look and feel” for all A/V room types.

C. Final programming A/V source code to remain property of the Owner. Provide copies of all AV room types compiled and uncompiled source code, to Owner for backup and future reference as part of the Final Acceptance.

D. DSP and any other applicable device configuration files to remain property of the Owner. Provide copies of all AV room types configuration files, to Owner for backup and future reference as part of the Final Acceptance.

2.06 AUDIO DSP

A. Approved products:
1. Biamp
2. Or approved equal

2.07 AUDIO AMPLIFIERS

A. Approved products:
1. Creston
2. Or approved equal

2.08 VIDEO SYSTEM

A. Approved products:
1. Creston
2. Or approved equal

2.09 PAN-TILT-ZOOM USB CAMERA

A. Approved products:
1. Vaddio
2. Or approved equal

2.10 CONTROL SYSTEM

A. Approved products:
1. Creston
2. Or approved equal

2.11 LOUDSPEAKERS

A. Approved products:
   1. Crestron
   2. Or approved equal

2.12 MICROPHONES

A. Approved products:
   1. Biamp
   2. Or approved equal

2.13 ASSISTED LISTENING SYSTEM

A. Approved products:
   1. Listen Technologies
      a. IR system with accessories as noted on plans and in compliance with ADA/TAS guidelines.

2.14 FLAT PANEL DISPLAY

A. Approved products:
   1. Samsung
   2. NEC
   3. LG
   4. Or approved equal
B. Requirements
   1. Minimum 16/7 commercial runtime rating.
   2. Connectivity as needed per schematics.

2.15 FLAT PANEL DISPLAY MOUNT

A. Approved products
   1. Chief
      a. PDR, TS525T, TS325T based on size requirements.
      b. Or approved Equal

2.16 FLAT PANEL DISPLAY BACKBOX

B. Approved products
   1. Chief
      a. PAC526FWP4
      b. Or approved Equal

2.17 DIGITAL SIGNAGE MEDIA PLAYER

A. Approved products:
   1. Brightsign

a. XT1144
b. Or approved equal

2.18 CABLES

A. All AV cabling is to be provided by AV Contractor.

B. Provide types and quantities per drawings and schedules.

C. Conductor Sizing:
1. Insulation shall be rated for a minimum of 300 volts.
2. Wire types and minimum sizes:
   a. 70 Volt Speaker Cable - 16 AWG, twisted, stranded CL2/CL2P.
   b. Low Impedance Speaker Cable – minimum 12 AWG, twisted, stranded CL2/CL2P.
   c. Microphone Level Cable - 22 AWG, with 22 AWG drain wire, shielded, twisted, stranded CL2/CL2P.
   d. Line Level Cable - 22 AWG, with 22 AWG drain wire, shielded, twisted, stranded CL2/CL2P.
   e. Low Voltage Control Cable - 18 AWG twisted, stranded CL2/CL2P.
   f. CAT-5/6 – low skew type.
   g. Digital Media – Per manufacturer (Crestron)

D. Minimum acceptable AVS systems wiring performance standards shall be as follows:
1. Speaker cable - Per ANSI WC57 standard test.
2. CAT-5/6 - Per ANSI/TIA/EIA-568-8.1 standard test.
3. Fiber optic cable - Per ANSI/TIA/EIA-568-B standard test.
4. RS 232 - Per ANSI/ WC66 standard test.
5. Line level shielded audio cable - Per ANSI WC66 standard test.
6. Microphone level shielded audio cable - Per ANSI WC66 standard test.
7. Video coax cable - Per ANSI/TIA/EIA–TSB-67standard test.
8. Multi-conductor control cable - Per ANSI WC57 standard test.
9. HDMI 2.0 – Premium High Speed

E. Approved manufacturers:
1. Crestron
2. West Penn
3. Belden Inc.
4. Extron

2.19 AV PATHWAY

A. Approved manufacturers:
1. Panduit
2. Cooper B-Line
3. Or approved equal

B. J-hooks or saddle bags shall be installed 4ft to 5ft apart. Uniform spacing should be avoided to minimize problems with signal degradation.

C. J-hooks or saddle bags shall be supported from decking or building structure using methods approved by the manufacturer.

D. Cable count shall not exceed manufacturer's recommended maximum. Add separate parallel J-hook pathway when cable count requires it.

2.20 CABLE CONNECTORS

A. Approved manufacturers:
1. Crestron
2. Extron
3. Neutrik

2.21 AV PATCH CABLES

A. Provide AV patch cables for all AV plates and interconnectivity locations.

B. Minimum 6' cables

C. Approved manufacturers:
1. Crestron
2. Extron
3. Cables To Go (Premium)
4. Or approved equal

PART 3 - EXECUTION

3.01 CONSTRUCTION MEETINGS

A. The Consultant and/or Owner will hold regular construction meetings to review the installation schedule. It is mandatory that the Contractor's project manager attend each meeting.

3.02 SITE INSPECTION

A. Continuously verify that the site conditions are in agreement with the Contract Documents and the AVS design. Notify Owner's representative immediately of conditions that affect the performance of the installed system.

B. Coordinate any required work that is not specified in the Contract Documents.

3.03 COORDINATION

A. Adequate conduit and back boxes are provided for the specified system installation.

B. Adequate power has been provided for the specified system installation.

C. Verify mounting location of all devices with Owner prior to installation.

3.04 GENERAL

A. The Contractor shall be responsible for providing all wire and cable as required for complete and operational system.

B. All cables must be continuous runs from device location to the final point of termination. No mid run cable splices will be allowed.

C. Make connections and splices with solderless devices that are mechanically and electrically secure in accordance with manufacturer's recommendations.

D. The cable installation techniques shall be such that the mechanical and communications characteristics of the cables are not degraded at the time of installation. Any special environmental requirements for equipment shall be specified.

E. Wiring Method: Install cables in raceways except in accessible indoor ceiling spaces, in hollow gypsum-board partitions, and as otherwise indicated. Conceal raceways and wiring except in unfinished spaces.

F. Distribution of the cabling will be accomplished through cable trays, J-hooks, cable runways, conduit raceways, ducts, core holes, extended columns, false half columns and plenums. Horizontal cable segments will be placed in cable trays and when they leave cable trays will be supported by distribution rings. Where cables converge at equipment room locations, they will be supported by cable runways and distribution rings. All cable placements shall be based on the enclosed drawings.

G. The Contractor shall not place wiring in the same conduit or raceway with wire for electrical power distribution.

H. Connectors to all devices in system shall be protected against moisture. Approval of the method shall not relieve the Contractor of full responsibility for proper application and workmanship of the materials in the manner specifically approved. All connector threads shall be treated with an approved silicone lubricant.

I. The Contractor shall be responsible for providing approved grounds for all AVS system equipment per the manufactures recommendations. The Contractor shall also be responsible for ensuring ground continuity by properly bonding all appropriate cabling, closures, cabinets, service boxes, and framework. All ground connections shall consist of minimum 12 AWG copper wire and shall be supplied from an approved building ground and bonded to the main electrical ground. Contractor must notify the Owner prior to making any changes in submitted system design and/or installation.

J. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools.

K. Splices, Taps, and Terminations: For power and control wiring, use numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

L. Grounding: Provide independent-signal circuit grounding per practices published by the manufacturer.

3.05 IDENTIFICATION, LABELING AND DOCUMENTATION

A. The Contractor shall label all termination devices, panels, enclosures and equipment rooms. The Contractor will mark each unit with permanently attached markings that will not impair the equipment or present a hazard to maintenance personnel.

B. Place wire identification numbers ¼" on each end of all conductors and or connectors by using sleeve type heat shrinkable markers. Install markers to be readable from left to right or top to bottom. Wire numbers shall be computer printed (Brady TLS2200 with Permasleeve cable marking labels or equivalent). Hand written labels are not acceptable.

C. Mark all spare conductors.

D. Contractor to maintain a progress set of design documents on the Project site. These documents shall be updated daily to reflect the current condition of the work and available for review by the Consultant and Owner when requested.

E. If changes occur prior to acceptance testing altering the documentation previously furnished. The Contractor shall formally update and reissue the relevant documentation to the Consultant and Owner.

F. Consultant and Owner will review all documentation for accuracy and completeness and may reject substandard submittals.

G. The Contractor shall establish and maintain complete system documentation, including documentation procedures, operational information, configuration information and drawings. Documentation shall include the following:
   1. Floor plan drawings indicating device locations, unique system point numbers with device legends indicating manufacturers and model numbers for each device.
   2. The unique system point number of a device shall identify either through the software or hardwire connection, the specific device or group of devices associated with the unique point number in the system.
   3. Floor plan drawings indicating conduit and wire routing and junction box locations.
   4. Wire routing shall include cable identification and terminal strip numbers.
   5. Mounting details for all equipment and hardware.
   6. Functional block diagrams for each system.
   7. Wiring details showing rack elevations, equipment wiring and terminations and inter-rack wiring.

3.06 FIELD QUALITY CONTROL

A. Inspection: Verify that units and controls are properly installed, connected, and labeled, and that interconnecting wires and terminals are identified.

B. Pre-testing: Align and adjust system and pretest components, wiring, and functions to verify that they comply with specified requirements.

C. Test Schedule: Schedule tests after pre-testing has been successfully completed and system has been in normal functional operation for at least 14 days. Provide a minimum of 10 days' notice of test schedule.

D. Operational Tests: Perform operational system tests to verify that system complies with Specifications. Include all modes of system operation. Test equipment for proper operation in all functional modes.

E. Remove and replace malfunctioning items and retest as specified above.

F. Record test results for each piece of equipment.

G. Re-test: Correct deficiencies identified by tests and observations and retest until specified requirements are met.

3.07 ADJUSTING

A. Speaker Systems
   1. Equalize speaker systems flat from 80 Hz to 2 KHz with a 2dB per octave roll-off thereafter. Program a high pass filter at 60Hz with 12dB per octave roll off and a low pass filter 15 KHz with 12 dB per octave roll off.
   2. Use a minimum of three measurement locations in the system's intended coverage area to calibrate the system response.
   3. Verify system gain and amplifier levels.
   4. Verify speaker polarity
   5. Adjust appropriate speaker delays.
   6. Set and adjust limiters.
   7. Contractor shall provide for calibration of the system:
      a. Sound analyzer (SmaartLive, TEF SoundLab, Meyer's SIM or equivalent) with trained operator for adjusting and verifying delay timing, cabinet aim and equalization.
      b. Suitable calibrated microphone.
   8. The Contractor shall coordinate this testing and calibration. It is anticipated that this work will take 1 hour per classroom. It will be necessary to have a quiet room during these times.
   9. Contractor to record all measurements, settings and adjustment for inclusion in the O&M manuals.

B. Adjust limit switches on electric operated projection screens.

C. Adjust back focus on all video cameras.

D. Occupancy Adjustments: When requested within 12 months following the of date of Substantial Completion, provide on-site assistance in adjusting systems to suit actual occupied conditions and to optimize performance of the installed equipment. Tasks shall include, but are not limited to, the following:
   1. Check cable connections.
   2. Check proper operation of equipment.
   3. Adjust all presets; consult Owner's personnel.
   4. Recommend changes to the AVS to improve Owner' utilization of the system.
   5. Provide a written report of adjustments and recommendations.

3.08 TRAINING

A. AVS training shall be provided for the operator/user and technical staff. Operator/user training shall minimally consist of two (2), 1-hour sessions. Technical operation and maintenance training shall minimally consist of two (2), 1-hour sessions. Training sessions to be coordinated with the Owner and scheduled no more than 6-months after substantial completion and before final acceptance.

B. Complete operation and maintenance manuals and preliminary as-built drawings shall be delivered to the Owner one week prior to the training sessions.

C. Provide a custom, system specific, laminated, quick reference guide (QRG) for the inexperienced operator.
   1. One (1) laminated hard copy.
   2. One (1) digital copy of all room types to be included with final documentation package.

D. Operator/user training shall minimally consist of:
   1. Provide custom system specific printed reference material for each trainee that documents and explains in layman's terms:
      a. Basic system block diagram.
      b. Normal day-to-day operation.
      c. Operator selectable features.
      d. Review QRG
      e. Provide a hands-on training with Q & A session

E. Technical Operations and Maintenance training shall consist of:
   1. The technical explanation shall be sufficiently thorough that: staff personnel shall be able to make any programming changes required, analyze malfunctions and make equipment substitutions or bypasses necessary to maintain system operation except for the malfunctioning equipment or circuits.
   2. Provide printed reference material for each trainee that documents and explains in technical terms:
      a. System block diagram with technical features.
      b. Technical operation, adjustments and programming.
      c. System features and programming.
      d. Review of as-built drawings.
      e. Review QRG
      f. Provide a hands-on training with Q & A session.

3.09 WARRANTY

A. The Contractor shall warrant the system for parts and labor for one (1) year. Warranty commences at the time of substantial project completion acceptance by Owner. Nothing shall be construed to limit this obligation to a shorter period.

B. Warranty service shall be rendered on-site by request of Owner to repair or replace any defective materials, equipment and workmanship without cost to the Owner, unless the Owner has previously given the Contractor a written acceptance of such condition.

C. The Owner shall give prompt notice of the defect(s) either verbally or in writing to Contractor.

D. Perform preventative maintenance during the warranty period, which includes:

   1. Cleaning and inspection of all devices every 6 months.

   2. Clean and vacuum console and rack equipment every 6 months.

E. Service technician performing service / warranty work shall check-in and out with Owner for each visit.

F. Provide a written report to Owner documenting any work performed during the warranty period within 24 hours of such event. Report shall detail work performed, equipment repaired or replaced, etc.

G. Provide loner equipment that is equivalent to the malfunction equipment for any equipment not field repairable.

H. Repair or Replacement Service.
   1. Repair or replacement service during the warranty period shall be performed 7 days a week, 24 hours a day and with a 4-hour response time.
   2. Emergency repair or replacement service during the warranty period shall be performed 7 days a week, 24 hours a day and with a 1-hour response time.
   3. If the Contractor cannot restore system operation during the warranty period within 2 business days of the system failure, the Owner reserves the right to require the Contractor to provide on-site manufacturer's service technicians at no additional cost.
   4. The Owner reserves the right to expand or add to the system during the warranty period using firm(s) other than the Contractor for such expansion without affecting the Contractor's responsibilities, provided the expansion is performed by an authorized dealer for the affected equipment.

3.10 SUBSTANTIAL COMPLETION

A. Work must meet the following requirements to qualify for the Owner's consideration of Substantial Completion:
   1. All AVS devices shall be fully installed, powered, online and fully operational.
   2. All sub-system interfaces must be complete and operational.
   3. Initial training schedule submitted.
   4. Owner may utilize the system for its designed intent.

B. Contractor will provide a list of remaining work items and approximate completion date.

C. Contractor will certify in writing that all remaining work is minor in nature and will be completed in less than 30 days.

3.11 TESTING REQUIREMENTS

A. The Contractor shall perform sample tests in the presence of the Consultant and Owner. Performing the testing procedures specified herein assures that the communication cabling and system electronics meets the performance characteristics specified.

B. All testing shall comply with EIA/TIA Standards and that of the equipment manufacturers. If testing indicates that the performance characteristics are not met, the test shall be failed test and any other test that may be affected by the modification and/or repair shall be rerun and verified.

C. Test equipment will be provided by the Contractor to test and to certify the 100% operational condition of all materials and equipment.

D. The Contractor shall prepare and submit all test procedures and data forms for the pre-installation, post installation and subsystem test to Owner. The test procedures shall have Owner approval before the tests.

3.12 SYSTEM CHECK OUT AND VERIFICATION

A. Verify continuity of cabling between field devices and controllers.

B. Commission all devices from field to front end.

C. Contractor supplied "As Built" Drawings shall show conduit routing.

D. Review all as-built documentation and Operation and Maintenance manuals with Owner. Revise and reissue as required.

E. Provide as-built / record drawing documentation in hard copy, PDF and AutoCAD formats.

F. Demonstrate proper sequences of operation for all devices.

3.13 FINAL ACCEPTANCE OF SYSTEMS

A. Each area of construction completed and submitted as complete shall meet the following criteria under testing:
   1. System must meet all specifications as described in these instructions.
   2. Operational prints, manuals, signal logs, and as-built prints must be furnished.
   3. Visual testing and signal verification will be conducted at random locations to determine that equipment performs satisfactorily.

B. Specifications set forth for construction of the system have been devised in order to insure system compatibility and performance. Compliance to these specifications will be determined during periodic observances of construction. Repeated failure to comply with the specification will be considered before the initial acceptance phase of the plant commences.

C. Within ten days receipt of the final acceptance notice, the Owner's representatives shall schedule and perform the final inspection. When the work is found acceptable under the contract documents and the contract is fully performed, declare the project complete.

END OF SECTION 27 40 00

SECTION 28 05 00 - COMMON WORK RESULTS FOR SECURITY

PART 1 - GENERAL

1.01 DESCRIPTION

A. This Section, Requirements for Electronic Safety and Security Installations, applies to all sections of Division 28.

B. Furnish and install electronic safety and security cabling, systems, equipment and accessories in accordance with the specifications and drawings. Capacities and ratings of, cable and other items and arrangements for the specified items are shown on drawings.

1.02 CODES, STANDARDS, REFERENCES, AND APPLICABILITY

A. NATIONAL ELECTRICAL CODE, NFPA 70.
   1. The National Fire Protection Association has acted as the sponsor of the National Electrical Code (NEC) since 1911. The original Code was developed in 1897 as a result of the united efforts of various insurance, electrical, architectural, and allied interests. The purpose of the NEC is the practical safeguarding of persons and property from hazards arising from the use of electricity. The NEC provides the minimum code requirements for electrical safety. In security distribution design, the NEC must be used in concert with the ANSI/TIA standards identified below, which are intended to insure the performance of the security infrastructure.

B. ANSI/TIA STANDARDS
   1. The Telecommunications Industry Association (ANSI/TIA) engineering standards and publications are designed to serve the public interest through eliminating misunderstandings between manufacturers and purchasers. The standards facilitate interchangeability and improvement of products, and assist the purchaser in selecting and obtaining the proper product for his or her particular need.

C. CABLING STANDARD, ANSI/TIA-568 (SERIES)
   1. The ANSI/TIA-568-C (series) is the Commercial Building Cabling Standard. This standard defines a generic security wiring system for commercial buildings that will support a multi-product, multi-vendor environment. It also provides direction for the design of security cabling products for commercial enterprise.
      a. The purpose of the standard is to enable planning and installation of building wiring with little knowledge of the security products that subsequently will be installed. Installation of wiring systems during building construction or renovation is significantly less expensive and less disruptive than after the building is occupied. TIA/EIA-568-A establishes performance and technical criteria for various wiring system configurations for interfacing and connecting their respective elements.

D. PATHWAYS AND SPACES, ANSI/TIA-569-C (SERIES).
   1. The ANSI/EIA-569-C (series) is the Commercial Building Standard for Pathways and Spaces. This standard will be followed for all low voltage systems in all Galveston County buildings. This standard encompasses security considerations both within and between buildings, and recognizes three fundamental concepts:
      a. Buildings are dynamic. Over the life of a building, or campus, remodeling is more the rule than the exception. The standard recognizes that changes will take place.
      b. Building security systems and media are dynamic. Over the life of a building, or campus, both security equipment and cabling change dramatically. The standard recognizes this fact by being as independent as possible from specific vendor equipment and media.

c. Security is more than just locks and cameras. Security also encompasses many building systems including environmental controls, fire alarms and emergency paging.
d. In order to have a building, or campus, successfully designed, constructed, and provisioned for security, it is imperative that the security design be incorporated during the preliminary architectural design phase. To accomplish this, the architect must work closely with the designated Security & IT staff members. Through the facilities planning and construction office.

E. GROUNDING AND BONDING, ANSI-J-STD-607-B (SERIES)
1. The ANSI-J-STD-607-B (series) is the Commercial Building Grounding and Bonding Requirements for Security. The National Electrical Code (NEC) provides grounding, bonding, and electrical protection requirements to ensure life safety. Modern security systems require an effective grounding infrastructure to insure optimum performance of the wide variety of electronic security systems that may be used throughout the life of a building. The grounding and bonding requirements of this standard are additional technical requirements for security that are beyond the scope of the NEC. These standards are intended to work in concert with the cabling topology specified in ANSI/TIA-568-C, and installed in the pathways and spaces designed in accordance with ANSI/TIA-569-C.

F. AMERICANS WITH DISABILITIES ACT (ADA)
1. The Americans with Disabilities Act defines accessible design considerations such as spacing between equipment, room layouts mounting heights and device and communications requirements applicable to Electronic Safety and Security designs and installations. It also contains regulations concerning alarms and signage.

G. OCCUPATIONAL SAFETY & HEALTH ADMINISTRATION (OSHA)
1. Through the Occupational Safety and Health Administration the federal government enforces the safety aspects of codes and standards that apply to employee working conditions. Guidelines for good practice when installing electronic safety and security systems are defined in the following documents:
a. 29CFR1910, Title 29, Labor-Part 1910 OSHA Standards.
1) 29CFR1926, Tit6le 29, Labor-Part 1926 Safety & Health Regulations for Construction.
2) Individual states may have their own occupational safety divisions. Most states or localities accept certification of electrical products by a national testing laboratory as evidence that products and materials are safe for use in that jurisdiction.

H. UNDERWRITERS LABORATORIES INC. (UL)
1. In the United States the Authority Having Jurisdiction (AHJ) typically requires UL testing and certification on electrical equipment. Some of the applicable standards are as shown below:
a. UL 294 (1999) Standard for Access Control System Units. UL 639 (1997) Standard for Intrusion-Detection Units.

I. THE BICSI ELECTRONIC SAFETY & SECURITY DESIGN REFERENCE MANUAL
1. The Building Industry Consulting Service International, Inc. (BICSI) is an information technology association whose mission is to provide state-of-the-art information technology and security knowledge to the industry, resulting in good service to the end user. BICSI develops and publishes the Electronic Safety and Security Design Reference Manual (ESSDRM). The ESSDRM is not a code or standard. The ESSDRM is an extensive volume of information on the various aspects of security systems and security distribution.
a. The ESSDRM provides discussions and examples of various engineering methods and design solutions that can be selected and employed in order to

meet the requirements of the NFPA and ANSI/TIA standards. Designers and installers are encouraged to use the ESSDRM as an engineering tool,

1.03 MINIMUM REQUIREMENTS

A. References to industry and trade association standards and codes are minimum installation requirement standards.

B. Drawings and other specification sections shall govern in those instances where requirements are greater than those specified in the above standards.

1.04 QUALIFICATIONS (PRODUCTS AND SERVICES)

A. Manufacturers Qualifications: The manufacturer shall regularly and presently produce, as one of the manufacturer's principal products, the equipment and material specified for this project, and shall have manufactured the item for at least three years.

B. Product Qualification:
   1. Manufacturer's product shall have been in satisfactory operation, on three installations of similar size and type as this project, for approximately three years.

PART 2 - PRODUCTS

2.01 GENERAL

A. Materials and equipment furnished shall be of current production by manufacturers regularly engaged in the manufacture of such items, for which replacement parts shall be available.

B. When more than one unit of the same class of equipment is required, such units shall be the product of a single manufacturer.

C. Equipment Assemblies and Components:
   1. Components of an assembled unit need not be products of the same manufacturer.
   2. Manufacturers of equipment assemblies, which include components made by others, shall assume complete responsibility for the final assembled unit.
   3. Components shall be compatible with each other and with the total assembly for the intended service.
   4. Constituent parts which are similar shall be the product of a single manufacturer.

D. Factory wiring shall be identified on the equipment being furnished and on all wiring diagrams.

2.02 EQUIPMENT REQUIREMENTS

A. Where variations from the contract requirements are requested in accordance with Section 00 72 00, GENERAL CONDITIONS and Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES, the connecting work and related components shall include, but not be limited to additions or changes to branch circuits, circuit protective devices, conduits, wire, feeders, controls, panels and installation methods.

PART 3 - EXECUTION

3.01 SUMMARY

A. Equipment and materials shall be protected during shipment and storage against physical damage, dirt, moisture, cold and rain:
   1. During installation, enclosures, equipment, controls, controllers, circuit protective devices, and other like items, shall be protected against entry of foreign matter; and be vacuum cleaned both inside and outside before testing and operating and repainting if required.
   2. Damaged equipment shall be, as determined by the Resident Engineer, placed in

first class operating condition or be returned to the source of supply for repair or replacement.

3. Painted surfaces shall be protected with factory installed removable heavy kraft paper, sheet vinyl or equal.
4. Damaged paint on equipment and materials shall be refinished with the same quality of paint and workmanship as used by the manufacturer so repaired areas are not obvious.

3.02 WORK PERFORMANCE

A. Job site safety and worker safety is the responsibility of the contractor.

B. For work on existing stations, arrange, phase and perform work to assure electronic safety and security service for other buildings at all times. Refer to Article OPERATIONS AND STORAGE AREAS under Section 01 00 00, GENERAL REQUIREMENTS.

C. New work shall be installed and connected to existing work neatly and carefully. Disturbed or damaged work shall be replaced or repaired to its prior conditions, as required by Section 01 00 00, GENERAL REQUIREMENTS.

D. Coordinate location of equipment and conduit with other trades to minimize interferences. See Section 00 72 00, GENERAL CONDITIONS.

3.03 EQUIPMENT INSTALLATION AND REQUIREMENTS

A. Equipment location shall be as close as practical to locations shown on the drawings.

B. Inaccessible Equipment:
   2. "Conveniently accessible" is defined as being capable of being reached without the use of ladders, or without climbing or crawling under or over obstacles such as, but not limited to, motors, pumps, belt guards, transformers, piping, ductwork, conduit and raceways.

3.04 SUBMITTALS

A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. The Owners approval shall be obtained for all equipment and material before delivery to the job site. Delivery, storage or installation of equipment or material which has not had prior approval will not be permitted at the job site.

C. All submittals shall include adequate descriptive literature, catalog cuts, shop drawings and other data necessary for the Owner to ascertain that the proposed equipment and materials comply with specification requirements. Catalog cuts submitted for approval shall be legible and clearly identify equipment being submitted.

D. Submittals for individual systems and equipment assemblies which consist of more than one item or component shall be made for the system or assembly as a whole. Partial submittals will not be considered for approval.
   1. Mark the submittals, "SUBMITTED UNDER SECTION_____".
   2. Submittals shall be marked to show specification reference including the section and paragraph numbers.
   3. Submit each section separately.

E. The submittals shall include the following:
   1. Information that confirms compliance with contract requirements. Include the manufacturer's name, model or catalog numbers, catalog information, technical data sheets, shop drawings, pictures, nameplate data and test reports as required.
   2. Elementary and interconnection wiring diagrams for communication and signal systems, control system and equipment assemblies. All terminal points and wiring

shall be identified on wiring diagrams.

3. Parts list which shall include those replacement parts recommended by the equipment manufacturer, quantity of parts, current price and availability of each part.

F. Manuals: Submit in accordance with Section 01 00 00, GENERAL REQUIREMENTS.
   1. Maintenance and Operation Manuals: Submit as required for systems and equipment specified in the technical sections. Furnish four copies, bound in hardback binders, (manufacturer's standard binders) or an approved equivalent. Furnish one complete manual as specified in the technical section but in no case later than prior to performance of systems or equipment test, and furnish the remaining manuals prior to contract completion.
   2. Inscribe the following identification on the cover: the words "MAINTENANCE AND OPERATION MANUAL," the name and location of the system, equipment, building, name of Contractor, and contract number. Include in the manual the names, addresses, and telephone numbers of each subcontractor installing the system or equipment and the local representatives for the system or equipment.
   3. Provide a "Table of Contents" and assemble the manual to conform to the table of contents, with tab sheets placed before instructions covering the subject. The instructions shall be legible and easily read, with large sheets of drawings folded in.
   4. The manuals shall include:
      a. Internal and interconnecting wiring and control diagrams with data to explain detailed operation and control of the equipment.
      b. A control sequence describing start-up, operation, and shutdown.
      c. Description of the function of each principal item of equipment.
      d. Installation and maintenance instructions.
      e. Safety precautions.
      f. Diagrams and illustrations.
      g. Testing methods.
      h. Performance data.
      i. Pictorial "exploded" parts list with part numbers. Emphasis shall be placed on the use of special tools and instruments. The list shall indicate sources of supply, recommended spare parts, and name of servicing organization.
      j. Appendix; list qualified permanent servicing organizations for support of the equipment, including addresses and certified qualifications.

G. Approvals will be based on complete submission of manuals together with shop drawings.

H. After approval and prior to installation, furnish the Resident Engineer with one sample of each of the following:
   1. A 300 mm (12 inch) length of each type and size of wire and cable along with the tag from the coils of reels from which the samples were taken.
   2. Each type of conduit and pathway coupling, bushing and termination fitting.
   3. Conduit hangers, clamps and supports.
   4. Duct sealing compound.

3.05 SINGULAR NUMBER

A. Where any device or part of equipment is referred to in these specifications in the singular number (e.g., "the switch"), this reference shall be deemed to apply to as many such devices as are required to complete the installation as shown on the drawings.

END OF SECTION

SECTION 28 1300 - ACCESS CONTROL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

1. Building access control system including intelligent field panels, input modules, output modules, power supplies, communications devices, and related equipment.
2. I Integrated Wiegand Output, Wireless, and IP-Enabled access control products are required to be sup-plied and installed only through designated ASSA ABLOY “Authorized Channel Partner” (ACP) and “Certified Integrator” (CI) accounts.

1.2 SUMMARY

A. Section Includes:

1. Access Control System Software
2. Access Control Head End Equipment
3. Access Control Field and Monitoring Devices

B. Substitutions and Pre-Qualification

1. Access Control System shall be the Access N Site Access Control Management System (no substitutions) so as too interface into the Owner’s existing Touch Net /Cougar One Card System.

C. Related Sections:

1. Section 08110 – Steel Doors and Frames
2. Section 08210 – Wood Doors
3. Section 08710 – Door Hardware
4. Section 08430 or 0860 – Automatic Entrance Doors
5. Section 14200 – Elevators
6. Section 16050 – Basic Electrical Materials and Methods
7. Section 16100 – Wiring Methods
8. Section 16400 – Low-Voltage Distribution
9. Section 270528 – Pathways
10. Section 270553 – Identification
11. Section 270526 – Bonding and Grounding

D. Related Work by Others

1. Door Hardware:

   a. Provide electrified door hardware for all card access doors, and for doors to be electronically locked and unlocked on a time schedule for all leaves.
   b. Provide request to exit switches (REX) on all electrified locking hardware and on all electrified exit devices. All exterior “Exit Only doors shall have the capabilities for door position monitoring and shut capabilities (REX sensor must be installed)

c. Provide electrified mortise locksets as 24VDC.
d. Provide electrified latch retraction for all electrified exit devices.
e. Provide exit device power supplies for all electrified exit devices. Exit device and power supply shall be of same manufacturer.
f. Provide electric through wire devices for all electrified door hardware.

g. Provide dedicated 120VAC power circuits, conduit, raceways, back boxes, j-boxes, fittings, hardware and earth grounds as necessary to provide a complete working system for the access control system. Provide 120VAC connections to access control head end equipment and access control system power supplies and door locking power supplies.
h. Install power supplies for electrified door hardware, unless otherwise noted.
i. Provide conduit and back boxes for cable protection within walls, to door jambs, stubbed above drop ceilings, within closed ceilings, where exposed, and penetrating all walls and ceilings. Conduit shall be provided to all access control and security devices, including but not limited to all card readers, electrified door hardware, door contacts, request to exit devices, system power supplies, power supplies for electrified door hardware and electrified exit devices, automatic door operators and associated controls, vehicle gate operators and associated controls, and all other access control and security related devices. Conduits shall be homerun from the security closet to the access-controlled door.
j. Provide necessary masonry coordination for the back-box installations.
k. Patch and paint all items relating to conduit, raceways, J boxes, fittings hardware and earth grounds, conduit, and conduit installations.
l. The installing electrician shall be present during the final walkthrough and system commissioning to resolve any electrical issues.

m. Provide and install demarcation box(s) in elevator room.

    1) One dry contact per floor for remote elevator actuation by access system.
    2) One input per floor for elevator indication to access system.
    3) Other inputs/outputs as specified in the drawings and specifications.

n. Wiring to the Cab
o. Card Readers as specified by the drawings and specifications.
p. Life safety, software and testing
    1) Elevator contractor responsible for following all code requirements.
    2) Responsible for all software necessary to interact with all input/output points connected to the access system relating to elevator.
    3) Provide an elevator technician for testing of the interfaces to access system.

q. Provide input interface for the control of the automatic door by card reader.
r. Provide one contact from each ADA button for interface with the AccessNSite Access System for “individual” ADA button control by card reader and/or time schedule.
s. Provide integral electrified door locking mechanisms for automatic “sliding” doors.
t. Provide integral door monitoring contacts for automatic “sliding” doors.

u. Provide one fire alarm relay with a dry contact at each Access N Site Access Control Head End for input to power distribution module(s) that control emergency door release when/if “fail-safe” locks are used.

v. Provide network connection to each Access N Site Head End and provide static IP addresses.

1.3 SYSTEM DESCRIPTION AND SCOPE OF WORK

A. AccesNsite is a total access control management system to be referred to as “System” as the existing access control system for Galveston County.. The System is a sophisticated, multi-tasking, multi-user Access Control Management System and is modular and network capable. The System has the ability of handling multiple sites, controls access with various reader technologies supported simultaneously, includes alarm monitoring with text and graphics-based annunciation, and allows for easy expansion or modification of readers, inputs, and outputs.

B. The System utilizes an existing central server and is managed under a single software program by the existing AccessNSite Control Server Software, which provides full integration of all system components. Reconfiguration shall be accomplished on-line through system programming, without hardware changes (except for database, operating system, or technology upgrades by Owner).

C. Access Control Contractor(s) shall provide and install the AcessNSite System for all specified doors including the following equipment: card readers, intelligent door controller, system enclosures, card reader panels, input panels, output panels, interface relays, power distribution modules, door contacts, egress motion detectors, exit buttons, door prop horns, key switches, system power supplies, fused relay outputs, back up batteries, and power distribution modules for fail-safe locks only (to be tied into the building fire alarm system).

D. Access Control Contractor(s) shall provide and install all low voltage plenum cabling to access control devices and electrified door hardware and make all low voltage connections.

E. Access Control Contractor(s) shall provide door lock power supplies if not provided with door hardware in Section 8710 (except for power supplies for latch retraction exit devices, which shall be provided by the door hardware supplier and shall be of the same manufacturer as the exit devices).

F. Access Control Contractor(s) shall provide specified AccessNSite client software (if specified), and associated training.

1.4 SUBMITTALS

1. Section 08110 – Steel Doors and Frames
2. Section 08210 – Wood Doors
3. Section 08710 – Door Hardware
4. Section 08430 or 0860 – Automatic Entrance Doors
5. Section 14200 – Elevators
6. Section 16050 – Basic Electrical Materials and Methods
7. Section 16100 – Wiring Methods
8. Section 16400 – Low-Voltage Distribution

B. Product Data: Provide Manufacturer’s Data and Catalog Cut Sheets for all access control equipment.

C. Device Schedules: Submit a schedule of access control devices and security equipment per door and per access control head end.

1.5 QUALITY ASSURANCE

A. Distributor's Qualifications:

1. Company shall be certified as an authorized dealer on the AccesNSite System.
2. Company shall have with a minimum of 1-year experience with the AccessNSite System.
3. Company shall provide programming only by factory trained technicians.

B. Arrange with the General Contractor for a coordination meeting with all subcontractors and material suppliers involved with the access control including doors, frames and door hardware supplier(s), elevator, automatic doors, entrances, electrical, and Owner's information services.

C. Review Submittals for doors, entrances and builder's hardware to confirm that adequate provisions will be made for proper installation and function for access control and door monitoring.

1.6 WARRANTY:

A. Warranty materials, fabrications, and installation for a period of 12 month upon substantial completion using factory-authorized service representatives.

1. Owner shall notify Access Control Contractor(s) by phone immediately upon noticing a security system problem, and integrator shall respond (during normal working hours, 8 am to 5 pm, Monday through Friday, excluding holidays or weekends), with a phone response within 2 hours after notification, and onsite technician response within 24 hours of notification. After hours, emergency, weekend, or holiday response shall be at additional cost.
2. Access Control Contractor(s) shall not be required to replace or warrant damage due to misuse, abuse, abnormal use, negligence, acts of God or vandalism.
3. Access Control Contractor(s) shall not be responsible for warranty, repair, or troubleshooting of any equipment provided by others.
4. Access Control Contractor(s) shall not be responsible for any existing field devices/equipment that is not functional for whatever reason.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

~~B.~~A. American Direct Procurement, Inc. is the sole supplier for the AccessNsite Access Control Security System (no substitutions).

~~1.7~~2.2 SYSTEM COMPONENTS

A. AccessNsite Access Control System Software

1. AccessNsite Access Control Server and Server Software – System shall utilize the existing Cougar One Card Access Control Server, Operating System, Database, and existing AccessNsite Access Control Server Software.
2. AccessNsite Access Control Client Software – Provide optional cost per client license, plus training cost. To be specified if building user needs to add, modify, or delete cardholders, access levels, time schedules for access or door lock/unlock intervals, for monitoring of door alarms, and running access control and alarm monitoring reports.
3. AccessNsite Area Access Manager Software – Provide optional cost per client license, plus training cost. To be specified if building user only needs to add existing cardholders to existing access levels and run reports on assigned readers/doors.

B. AcessNsite Access Control Head End Equipment – as required for specified field devices on plan drawings. Locations shall be installed in security closets with the dimensions of 5’ x 8’ room to be secured by card reader, as specified in Section 28 10 00 - 2.

1. Intelligent Dual Reader Controllers (IDRC) – Mercury 1502 Dual Reader Controller,
   a. On-board Ethernet 10/100Base-T port, RS232 port, and RS485 port.
   b. Two (2) Reader ports.
   c. Two (2) Electric Lock Output (one per door), Form-C outputs, 5 A at 30 VDC.
   d. Two (2) Auxiliary Output (one per door), Form-C outputs, 5 A at 30 VDC.
   e. Two (2) Door Contact supervision (open/closed) (one per door).
   f. Two (2) REX (request to exit) Monitor (one per door).
   g. Individual extended held open and strike times (ADA required).
   h. 6 MB of available on-board, non-volatile flash memory.
   i. Provide one controller per security closet room or connect to existing AccesNsite controller if applicable.

2. Single Reader Interface Panels (SRI) – Mercury MR50 Single Reader Panel,
   a. One Reader port.
   b. One Electric Lock Output (one per door), Form-C output, 5 A at 30 VDC.
   c. One Auxiliary Output (one per door), Form-C outputs, 1 A at 30 VDC.
   d. One Door Contact Supervision (open/closed).
   e. One REX (request to exit) Monitor.
   f. Individual extended held open and strike times (ADA required).

3. Dual Reader Interface Panels (DRI) – Mercury MR52 Dual Reader Panel,
   a. Two (2) Reader ports.
   b. Two (2) Electric Lock Outputs (one per door), Form-C outputs, 5 A at 30 VDC.
   c. Four (4) Auxiliary Output (one per door), Form-C outputs, 5 A at 30 VDC.
   d. Two (2) Door Contact Supervision (open/closed) (one per door).
   e. Two (2) REX (request to exit) Monitor (one per door).
   f. Individual extended held open and strike times (ADA required).

4. Input Modules (IM) – Mercury MR16IN Input Panel,
   a. Line Supervision.
   b. Sixteen (16) programmable supervised or non-supervised contacts.
   c. Two (2) Form-C 5 A, 30 VDC Relay output contacts.
   d. Two (2) dedicated inputs for tamper and power failure status.
   e. Door Monitoring, Alarm Monitoring, and Elevator Control inputs.

5. Output Modules (OM) – Mercury MR16OUT Output Panel,

a. a. Sixteen (16) Form-C 5 A, 30 VDC programmable relay outputs.
b. b. Two (2) dedicated digital inputs for tamper and power failure status.
c. c. Door Control and Elevator Control outputs.

6. System Power Supplies (SPS) – Life Safety Power (model number as required)
   a. Amperage based on connected equipment.
   b. Provide with 25% spare capacity.
   c. Provide fused outputs.
   d. Provide battery backup for up to 4 hours.
   e. Provide lockable enclosures as required.
   f. Provide system power supplies separate from lock power supplies.

7. Interface Relays (IR) – Altronix, GE, or Honeywell
   a. 12 or 24VDC relay coil.
   b. Output voltage and current rating as required for interface.
   c. For use with automatic door, elevator, or vehicle gate controls interface.

8. Lockable System Enclosures (Head End) – Life Safety Power
   a. Lockable Metal Enclosure.
   b. Supports up to six (8) Mercury panels per enclosure.
   c. Provide sufficient enclosures for connected equipment.

9. Power Distribution Modules (PDM) – Life Safety Power
   a. Five (5) Individual Outputs (one per locking device).
   b. Input from fire alarm system disables power to all connected devices.
   c. For use with “fail-safe” locking devices only.
   d. Fire Alarm Relay provided by others next to Head End.

C. Access Control Field and Monitoring Devices – as shown on plan drawings.

1. Card Readers, Magnetic Stripe (CR-MS) – No Longer Supported
   a. Fully weatherized metal casing, black.
   b. Bi-directional high coercively magnetic card swipe.
   c. One million card pass read head.
   d. Maximum 500 feet (152 m) distance from reader interface panel.
   e. Provide with back plate or weather shield as required.
   f. Used at all card access doors for use with UH Cougar One Card.
   g. Provide with keypad option if specified on plan drawings.

2. Card Readers, DesFire EV1 (CR-EV1) –
   a. HID iClass SE R 15 Mini- Readers for use when mounted on aluminum mullions. Model # 910NMNNEKEA129
   b. HID iClass SE R40 Wall Reader Model # 920NMNNEKEA129
   c. Maximum 500 feet (152 m) distance from reader interface panel.

3. Egress Motion Detectors (EMD) – Bosch, GE, Optex, or Honeywell
   a. passive infrared detector.
   b. Adjustable zone detection for egress.
   c. Unlocks or shunts door automatically.
   d. Hands free.

4. Exit Buttons (EB) – Alarm Controls, Locknetics, or Securitron
   a. Double pole (DP) contacts – connect one pole directly to magnetic lock power and connect one pole as request to exit to AccessNSite System.
   b. Provide 30 second pneumatic delay (not dependent on electronics to operate).
   c. Provide 2” min. red mushroom button with exit signage “Push Button to Exit”.
   d. Provide only for use with magnetic locks, in addition to egress motion detector.

5. Door Contacts (DC) – Bosch, GE, or Honeywell
   a. Concealed 3/4" or 1” diameter (surface mount where concealed is impractical).
   b. Self-lock mounting.
   c. Rugged construction.

6. Door Prop Horns (DPH)
   a. Decibel level as specified on plan drawings.
   b. 12VDC power.

7. Key Switches (KS) – Best Access (no substitutions)
   a. Maintained or momentary key switch functions.
   b. Accepts Best Access key-removable core (UH keying system standard).
   c. Single, double, or triple pole, depending on the interface.
   d. Voltage and current rating, depending on the interface.
   e. Used for interface with door prop horns, automatic doors, emergency override.

D. IP Enabled Wireless Integrated Card Reader Mortise Locks: IP enabled Wi-Fi™ technology ANSI/BHMA A156.13 Grade 1 mortise lockset with integrated card reader, deadbolt monitoring, and request-to-exit and door position switch signaling in one complete unit. Motor driven locking/unlocking control of the lever handle trim, 3/4" deadlocking stainless steel latch, and 1" hardened steel deadbolt (optional). Lock is U.L listed and labeled for use on up to 3-hour fire rated openings. Available with or without keyed high security cylinder override.

1. Wireless access control mortise locks interface using field replaceable IEEE 802.11b/g/n 2.4 GHz wireless radio connection to an Ethernet Local Area Network (LAN), facilitating central control via a Software Development Kit (SDK). Locks will continue to operate independently of an Ethernet (LAN) connection slowdown or failure.
2. Fully encrypted AES 128 wireless communication between IP enabled lock and access control system via the Software Development Kit (SDK).
3. Integrated card reader supports HID® 125kHz proximity credentials; or ISO 14443 A/B and ISO 15693 13.56 MHz contactless credentials: HID® iCLASS (full authentication, all formats), MIFARE Classic, DESFire EV1 (full authentication, all formats); or Near Field Communications (NFC).
4. Configuration: Locks require a minimum of 2,400 user codes and the ability to audit the last 10,000 transactions. Programmable for time zone periods, holidays, and automatic unlock (with or without first entry).
5. Power Source: 6 AA alkaline batteries with LED indication of locked, programming mode and low capacity warning status conditions.
6. Complete installation to include Software Development Kit (SDK), and network and lock configuration CD tool kit for initial lock set-up. Electronic on-line access control system platform, including communication cabling and software, by others.

7. Acceptable Manufacturers:

   a. Sargent Manufacturing (SA) – IN120- Series: “70/72 IN120-82278 IP/IPS LNP”
   b. No Substitution – Facility Standard.

E. IP Enabled Power-over-Ethernet (PoE) Integrated Card Reader Mortise Lock: IP enabled ANSI/BHMA A156.13 Grade 1 mortise lockset with integrated credential reader, request-to- exit, and door position signaling in one complete unit. Motor driven locking/unlocking control of the lever handle trim, 3/4" projection latch bolt, and optional 1" steel deadbolt. Lock is U.L listed and labeled for use on up to 3-hour fire rated openings. Available with or without keyed high security cylinder override.

1. Completely intelligent and integrated locking unit with Ethernet power and communication connection capability directly from the locking unit back to the central system host server without additional access control interfaces or components (excluding PoE End span and Midspan devices) via an existing or newly installed IEEE 802.3af PoE enabled network.
2. Open architecture design supports wired integration with third party access control systems applications via software development kit (SDK). Real-time software accessible alarms for forced door, unknown card and door held open, with inside lever handle (request-to-exit), battery status, tampering, and door position (open/closed status) monitoring.
3. 2,400 users and 10,000 event transaction history (audit trail). Distributed intelligence allows standalone operation in absence of network communication allowing for system operational redundancy.
4. Provide a network and lock configuration CD tool kit for initial lock setup and programming via a USB connection.
5. Integrated reader supports the following credentials:

    a. 125kHz proximity credentials: HID, AWID, Indala, and EM4102.
    b. 13.56 MHz contactless credentials: HID iClass, HID iClass SE, HID iClass Seos, SIO on MIFARE Classic, SIO on MIFARE DESFire EV1, MIFARE Classic, DESfire EV1, NFC-enabled mobile phones, Bluetooth Smart-enabled mobile phones.

6. Communication between access control system and device is protected by AES 128-bit encryption via the SDK. Programmable for time zones, holidays, and automatic unlocking.
7. Power and communication from one Ethernet (CAT5e or higher) cable. Compliant with 802.3af Class 1 device specifications requiring 3.84 watts for Power over Ethernet.
8. Supports real-time system lockdown capabilities. Inside lever retracts latch bolt and deadbolt simultaneously.
9. High security mechanical key provides emergency override retraction of latchbolt without need for electronic activation.
10. Ethernet system framework, network cabling, mounting boxes, PoE end-span/mid- span, electrical hard wiring, grounding, and connections are required for complete system functionality. All system components are by others and are specified elsewhere.

    a. Power Requirement: PoE Class 2, maximum 7 watts.
    b. Network Cabling Requirements: Cat5e or higher meeting or exceeding ANTSI/TIA/EIA-568-C. 24 AWG Plenum rated
    c. Bonding and Grounding: Meet or exceed TIA-607-B requirements. Connect device ground cable to building electrical earth ground.
    d. Network Surface Mount Box: Meet or exceed ANSI/TIA/EIA-568-C requirements. Cat5e or higher (RJ45).

        1) Acceptable Manufacturers:

            a) Sargent Manufacturing (SA) – IN220 Series: “70/72 IN220 82278 IP/IPS LNP”
            b) b. No Substitution – Facility Standard.

F. IP Enabled Wireless Exit Hardware: IP-enabled, Wi-Fi™ ANSI/BHMA A156.3 Grade 1 rim and mortise exit device hardware with integrated card reader, touch bar monitoring, and request-to-exit signaling in one complete unit. Motor driven locking/unlocking control of the lever handle exit trim with 3/4" throw latch bolt. U.L listed and labeled for either panic or "fire exit hardware" for use on up to 3-hour fire rated openings.

1. Wireless access control mortise locks interface using field replaceable IEEE 802.11b/g/n 2.4 GHz wireless radio connection to an Ethernet Local Area Network

(LAN), facilitating central control via a Software Development Kit (SDK). Locks will continue to operate independently of an Ethernet (LAN) connection slowdown or failure.

2. Fully-encrypted AES 128 wireless communication between IP enabled lock and access control system via the Software Development Kit (SDK).
3. Integrated card reader supports HID® 125kHz proximity credentials; or ISO 14443 A/B and ISO 15693 13.56 MHz contactless credentials: HID® iCLASS (full authentication, all formats), MIFARE Classic, DESFire EV1 (full authentication, all formats); or Near Field Communications (NFC).
4. Configuration: Locks require a minimum of 2,400 user codes and the ability to audit the last 10,000 transactions. Programmable for time zone periods, holidays, and automatic unlock (with or without first entry).
5. Power Source: 6 AA alkaline batteries with LED indication of locked, programming mode and low capacity warning status conditions.
6. Complete installation to include Software Development Kit (SDK), and network and lock configuration CD tool kit for initial lock set-up. Electronic on-line access control system platform, including communication cabling and software, by others.
7. Acceptable Manufacturers:

    a. Sargent Manufacturing (SA) – IN120-80/79 Series.
    b. No Substitution – Facility Standard.

G. IP Enabled Power-over-Ethernet (PoE) Integrated Card Reader Exit Hardware: IP enabled, PoE ANSI/BHMA A156.3 Grade 1 rim and mortise exit device hardware with integrated credential reader, touch bar monitoring, and request-to-exit signaling in one complete unit. Motor driven locking/unlocking control of the lever handle exit trim with 3/4" throw latch bolt. U.L listed and labeled for either panic or fire exit hardware for use on up to 3-hour fire rated openings. Available with or without keyed high security cylinder override trim.

1. Completely intelligent and integrated locking unit with Ethernet power and communication connection capability directly from the locking unit back to the central system host server without additional access control interfaces or components (excluding PoE End span and Midspan devices) via an existing or newly installed IEEE 802.3af PoE enabled network.
2. Open architecture design supports wired integration with third party access control systems applications via software development kit (SDK). Real-time software accessible alarms for forced door, unknown card and door held open, with push rail (request-to-exit), battery status, tampering, and door position (open/closed status) monitoring.
3. 2,400 users and 10,000 event transaction history (audit trail). Distributed intelligence allows standal one operation in absence of network communication allowing for system operational redundancy.
4. Provide a network and lock configuration CD tool kit for initial lock setup and programming via a USB connection.
5. Integrated reader supports the following credentials:

    a. 125kHz proximity credentials: HID, AWID, Indala, and EM4102.
    b. 13.56 MHz contactless credentials: HID iClass, HID iClass SE, HID iClass Seos, SIO on MIFARE Classic, SIO on MIFARE DESFire EV1, MIFARE Classic, DESfire EV1, NFC-enabled mobile phones, Bluetooth Smart-enabled mobile phones.

        1) Communication between access control system and device is protected by AES 128-bit encryption via the SDK. Programmable for time zones, holidays, and automatic unlocking.
        2) Power and communication from one Ethernet (CAT5e or higher) cable. Compliant with 802.3af Class 1 device specifications requiring 3.84 watts for Power over Ethernet.
        3) Supports real-time system lockdown capabilities

4) High security mechanical key provides emergency override retraction of latch bolt without need for electronic activation.
5) Ethernet system framework, network cabling, mounting boxes, PoE end-span/mid- span, electrical hard wiring, grounding, and connections are required for complete system functionality. All system components are by others and are specified elsewhere.

a) Power Requirement: PoE Class 2, maximum 7 watts.
b) Network Cabling Requirements: Cat5e or higher meeting or exceeding ANTSI/TIA/EIA-568-C. 24 AWG Plenum rated
c) Bonding and Grounding: Meet or exceed TIA-607-B requirements. Connect device ground cable to building electrical earth ground.
d) Network Surface Mount Box: Meet or exceed ANSI/TIA/EIA-568-C requirements. Cat5e or higher (RJ45).

6. Acceptable Manufacturers:

a. Sargent Manufacturing (SA) – IN220 80/79 Series.
b. No Substitution – Facility Standard

~~PART 2 -~~ PART 3 - EXECUTION

~~2.1~~4.1 INSTALLATION:

A. COORDINATION
1. Coordinate meeting with all subcontractors and material suppliers involved with the access control including doors, frames and door hardware supplier(s), elevator, automatic doors, entrances, electrical, and Owner's information services.

B. INSTALLATION STANDARDS
1. Install access control system components per manufacturer's instructions and recommendations.

C. ACCESSIBILITY
1. Comply with ANSI A117.1 Accessibility Standard requirements for disabled.

D. CABLING
1. 1. Install plenum cabling and wiring in raceways (by electrical contractor), and with j-hooks above drop ceilings, without damaging conductors, shield, or jacket.

E. LABELING
1. Label access control panels with access door information provided by Owner.

F. PROGRAMMING
1. Program all system and door set up information.
2. Owner shall program all cardholders and access levels.
3. Owner shall provide final door labeling information for programming.
4. Engage a factory-authorized service representative to test and adjust field-assemble components and equipment installation, including connections, and assist in field testing.

G. ACCEPTANCE TESTING
1. Operational Test and Acceptance: With Owner and General Contractor representatives, after installation of access control equipment, cables and connections, demonstrate system capability and compliance with requirements. Acceptance of access control system shall be independent of equipment or services provided in other sections or by Owner.

END OF SECTION 13750

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SECTION 28 23 00 - VIDEO SURVEILLANCE

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Cameras.

B. Control equipment.

C. Cable and accessories.

1.2 RELATED SECTIONS

A. Section 08 71 00 - Door Hardware.

B. Section 11 12 00 - Parking Control Equipment.

C. Section 14 20 10 - Passenger Elevators.

E. Section 28 05 00 - Common Work Results for Electronic Safety and Security

F. Section 28 05 26 - Grounding and Bonding for Electronic Safety and Security.

G. Section 28 05 28 - Pathways for Electronic Safety and Security.

H. Section 28 05 53 - Identification for Electronic Safety and Security.

I. Section 28 06 00 - Testing for Electronic Safety and Security.

J. Section 28 13 00 – Access Control.

K. Section 28 16 00 – Intrusion Detection.

L. Section 28 26 00 - Electronic Personal Protection System.

M. Conduit, cable tray and back boxes for this system shall be furnished and installed by the electrical contractor under the supervision of the security contractor.

N. See Division 26 for all information relating to the fire alarm system and required relay interface to release emergency delay exit doors. The fire alarm integrator shall provide the control relays as required.

1. See Division 16 for all specifications governing the performance of work associated with the installation of raceway, system junction and pull boxes and device rough-in boxes for all work shown in the Access Control System refer to

the SC series security drawings.

1.3 REFERENCES

A. NFPA 70 - National Electrical Code; National Fire Protection Association; 2005

B. EIA/TIA-569 Standard, Commercial Building Standard for Telecommunications Pathways and Spaces.

C. EIA/TIA-607 Commercial Building Grounding and Bonding Requirements for Telecommunications

D. National Electrical Code (NEC) (Latest revision and pertinent addendums)

E. National Fire Protection Association (NFPA) Publications (Latest revisions and pertinent addendums)

F. Americans with Disabilities Act (ADA)

G. NFPA 101, National Fire Protection Association

H. UL 294, Underwriter's Laboratories Access Control Systems

I. UL 1037, Underwriter's Laboratories Anti-Theft Alarms and Devices

J. UL 1076, Underwriter's Laboratories Propriety Burglar Alarms Units and Systems

K. EIA-RS-170 Broadcast Standards

L. NTSC Color System Standards

M. Building Officials and Code Administrators International, Inc. (BOCA) National Building Code

N. Uniform Building Code (UBC)

O. Local Governing Authorities Having Jurisdiction

1.4 CONTRACT DOCUMENTS

A. All work of this Section shall comply with the requirements of the Conditions of Contract (including: Bidding requirements, Contract forms, Conditions of Contract and Standard forms), with all Specification Sections of Division 1 General Requirements, with the Drawings, and with all other Contractual Documents.

B. Coordinate with other Division sections as required.

1.5 SYSTEM DESCRIPTION

A. This Section specifies the requirements for the Video Surveillance system for the Galveston County Road and Bridge Facility

B. Scope of Work

1. The work detailed by these specifications and drawings has been specified to meet certain requirements for performance. Some information, such as exact equipment layout, wire routing, additional conduit and power requirements, etc. has been omitted. It shall be the responsibility of the Contractor to translate these specifications and drawings into a complete design package containing all necessary elements for a complete turnkey installation including all material, labor, warranties, shipping and permits.
2. Work shall include the installation and commissioning of the following:
   a. Video Surveillance System (VSS)

3. Work to include, but not limited to the following:

   a. Perform camera pre-installation sign-off walk through with Owner and Security Consultant.
   b. Installation of cameras and camera cabling
   c. Provide all required storage hardware, software and licenses to the Owner.
   d. Contractor shall provide continuous on-site supervision of the installation technicians. On-site supervision shall include daily supervision of the work, updating work site progress drawings to reflect changes and installations details, preparing weekly progress reports and attendance at site coordination meetings as directed by the Owner and Security Consultant.
   e. The Contractor shall provide continuous engineering and programming support during the installation as required to accommodate existing conditions and unforeseen conditions that may arise during performance of the work.
   f. The Contractor shall provide all miscellaneous hardware including cable management devices, termination cabinets, wire and cable labeling materials, fasteners, hangers and brackets as required.
   g. The contractor will coordinate the delivery and storage of all materials, wire, cable, equipment and miscellaneous hardware.

4. Description: Provide video communications between points of surveillance indicated on Drawings and central monitoring station.
5. The contractor shall provide all materials, equipment, labor and all other incidental material, tools, appliances and transportation as required for a complete and functional video surveillance system (VSS) as described herein and supplementary drawings.
6. General elements of the work shall consist of but not limited to:

   a. Procure all permits and license required to complete this installation.
   b. Submission of Schedule of Values for all equipment, materials and labor.
   c. Attend pre-construction/pre-submittal meeting with Owner and Security Consultant to review design package for security and finish hardware.
   d. Submittal preparation and processing prior to ordering equipment.
   e. Attend finish hardware submittal review meeting.

f. Coordination of conduit system, raceway and power distribution provided by Electrical contractors.
g. Coordination with all trades and Owner representatives as required facilitating the installation of the security equipment including: Door Hardware, Fire Alarm Electrical.
h. Provide security system sensors, cable, connectors, wiring, equipment enclosures and all other materials necessary to complete the security system per the design documents.
i. Verify conditions and dimensions at the job site prior to installation.
j. Coordinate all system programming and camera naming with Owner.
k. Perform pre-installation camera position and view sign off with Owner
l. Perform installation according to contract documents and manufacturers recommendations.
m. Protect new facilities finishes and equipment.
n. Maintain construction materials and refuse within the area of work.
o. Clean the work area at the end of each day.
p. Perform initial testing and adjustments with written reports.
q. Make final adjustments and calibrations as directed by the Owner and Security Consultant.
r. Demonstrate all systems and component operations for final acceptance.
s. Preparation of O&M manuals and as-built documents for Owner's use.
t. Provide training for Owner's security staff, facility personnel and technical staff.
u. Provide warranty service for a period of one year from acceptance date.
v. Provide extended maintenance service.

1.6 SUBMITTALS

A. See Section 01 33 00 - Submittal Procedures.

B. Shop Drawings: Indicate electrical characteristics and connection requirements, including system wiring diagram.

C. Provide a schedule demonstrating that the selected camera and lens at each camera location meets the required use criteria. Schedule shall include all PPF and lens calculations.

D. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of product.

E. Operation Data: Instructions for starting and operating system.

F. Maintenance Data: Routine trouble shooting procedures.

G. The submittal shall be a detailed response describing methods, procedures and specific equipment proposed to conform to the system design detailed in these documents.

H. Submittals shall consist of product data, shop drawings, samples and detailed

completion schedules.

I. Partial submittals shall not be accepted without prior approval by Owner.

J. No portion of the work shall commence, or equipment ordered until the Owner has approved the submittals.

K. The Contractor shall not be relieved from any contract-required responsibility by the Owner's approval of submittals.

L. Nothing in the specification shall relieve the Security Contractor of responsibility in delivering a functioning turnkey security system.

1.7 SUBMITTAL REQUIREMENTS

A. Product Data

1. Provide Submittals no less than 10 working days after notice to proceed.
2. Submit data in 3-ring binder divided into separate section (Access Control, Video Surveillance, etc.) for each system.
3. Equipment lists and equipment data sheets shall be 8.5" x 11" in size.
4. Each section to include the following:

    a. List all system components with an assigned item number, manufacturer, model number and quantities of each.
    b. Manufacturer's literature sheets for all materials and equipment, including warranty information and recommended preventative maintenance and spare part inventory recommendations. Literature containing more than one device shall be clearly marked to delineate item(s) included in the work.
    c. Clearly indicate color or special finishes.
    d. Cable types including manufacturer's verification and acceptance information.
    e. General functional description of each system including:

        1) Description of operating systems and application software.
        2) Power requirements and UPS sizing.

5. Schedule of Values

    a. Contractor shall submit in addition to Division 1 requirements, a Schedule of Values, which includes itemized listing of all equipment, materials and labor required for the installation of the VSS as specified herein for Change Order pricing. Listing shall contain assign item number, item description, item model number, item quantity, unit cost and extended labor, material and installation cost to provide a complete and functional security system. Submit in electronic format (Microsoft Excel).

6. Shop Drawings

a. Provide Shop Drawings no less than 25 working days after notice to proceed.
b. Reproducing Contract Documents for shop drawing is not acceptable.
c. Submit 3 complete sets of shop drawings along with CD-ROM copy to the Security Consultant.
d. Produce all shop drawings on latest version of AutoCAD.
e. Shop drawings to include the following:

1) Drawing legend sheet describing all symbols used on the drawings.
2) Floor plans with all device locations and wiring.
3) Wire runs to include tags for type, gauge, quantities and cable identifiers.
4) System riser diagram indicating all field devices, riser paths and room designations.
5) Block diagram for each system showing: all equipment, interconnections, network connections and data flow.
6) Point schedule-defining interconnection of all inputs and outputs for all equipment including fire alarm interface, data connections and other systems.
7) Schedule of device power requirements, power source and load calculations.
8) Elevations of equipment racks with new equipment.
9) Elevations of electrical closet(s) with security DGP panel, termination enclosure, wire management, lock power supply(s), UPS, and power routing, etc.
10) Fabrication shop drawings for all custom equipment.

7. Samples

a. Upon specific request of the Owner and Security Consultant, submit samples of any proposed devices.

8. Resubmitting

a. Make corrections or changes in Submittals as required by the Security Consultant's stamped instructions and attached comments and resubmit.
b. Identify changes on resubmittals by clouding. Only indicated changes will be reviewed when resubmitted.
c. Added drawings shall be clearly identified.
d. Contractor shall be responsible for project delays caused by rejected submittals.
e. Security Consultant shall be compensated for additional services for submittals rejected more than twice. The amount of such compensation shall be incorporated by change order and withheld from the Contractor's Application for Payment.

1.8 RECORD DOCUMENTATION

A. Furnish 3 complete sets of record documents.

B. Record documents shall include all revised information provided as submittals and reflect as installed revisions.

C. General Description and Requirements

1. Record drawings shall consist of As-Built Drawings and Operation and Maintenance Manuals.
2. Transmit 3 copies of a preliminary draft of the Record Documents to the Owner and Security Consultant prior to final acceptance testing and training.
3. Update all Record Documents to reflect changes or modifications made during final acceptance testing as required.
4. Submit 3 sets of final corrected Record Documents to the Security Consultant within 30 days from the date of final acceptance.
5. As-Built Drawings

   a. Furnish 3 complete sets of as-built drawings along with a complete CD-ROM copy.
   b. Maintain on the job site, current up to date as-built drawings and schedule(s) including most recent changes. Included field notes shall be neat and legible. The Contractor shall make any needed changes to this drawing and schedule set as to accurately depict the as-built condition of the security system as it is installed.
   c. As-built Drawings shall, at a minimum, include the following:

      1) Floor plan drawings (1/8"=1' scale) indicating device location, with device legends indicating manufacturer and model number for each device.
      2) Floor plan drawings (1/8"=1' scale) indicating wire routing or approximate routing for existing wiring. Wiring shall be tagged with cable identifier and terminal strip number, which references wiring schedules.
      3) Mounting details for all equipment and hardware.
      4) Functional block diagrams for each system and subsystem.
      5) Wiring details showing rack elevations, DGP and support equipment elevations, equipment wiring and terminations and inter-rack wiring.
      6) Typical point-to-point wiring for each piece of equipment and groups of equipment within the system.
      7) Schedule of all devices with associated panel termination, zoning, power circuit numbers, etc.

6. Operational and Maintenance (O&M) Manuals

   a. Provide 3 complete operation and maintenance manuals for all equipment and devices with project title and contractor's name on cover and spine.
   b. Submit operation and maintenance manuals in 3 ring binders.
   c. O&M manuals shall include:

      1) Provide table of contents page with tabbed divider sections for each device or system.
      2) Tabbed sections shall include theory of operation, design philosophy,

specific functions and system block diagram.

3) List of manufacturers', their local representatives and subcontractors that performed work on the project. List to include contact names, addresses and phone numbers for each.
4) Custom written instructions and procedures for system operation.
5) Operator commands.
6) Start-up and shutdown procedures.
7) Detailed programming descriptions for each system.
8) Manufacturer's operation manual for each piece of equipment in the system. Product data sheets are not acceptable.
9) Custom written quick users guide for inexperienced operators.
10) System backup disk.
11) System software licenses.
12) Equipment list, including a brief description, model, and the total number of each item used in the project.
13) A separate list of serial numbers for all items used in the system
14) Copies of all programming specific to the job, including new code, initial parameters, and settings entered on site, etc.
15) Setup procedures for each component in the system.
16) Maintenance requirements for equipment, inspections and preventative maintenance schedules.
17) Final test data (measured levels and other significant operating parameters).
18) List of system associated mechanical locking keys and tamper resistant hardware types with key codes.

1.9 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.

B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience and with service facilities within 100 miles of Project.

C. Supplier Qualifications: Authorized distributor of specified manufacturer with minimum three years documented experience.

D. Installer Qualifications: Authorized installer of specified manufacturer with service facilities within 100 miles of Project.

E. Products: Furnish products listed and classified by Underwriters Laboratories, Inc. as suitable for purpose specified and indicated.

F. Contractor Qualifications

1. An experienced Contractor shall perform the installation. Contractor shall have at least 5 years' experience in the installation of security systems of similar size and scope.
2. The installation shall be performed by a Contractor licensed by the Texas Board

of Private Investigators and Private Security Agencies and shall be bonded and insured.

3. All installation personnel shall also be licensed as required by local and/or state jurisdictions.
4. Contractor shall provide all licensing documentation as part of the bid.
5. Owner's representative may make such investigations as deemed necessary to determine that the Contractor is responsive, responsible and qualified in the area of work contemplated by the contract. In this regard, the security system installation firm shall furnish to the Owner such information and data as shall be requested for this purpose. Information and data may include (but not necessarily be limited to): Date of organization and/or incorporation and number of years engaged in this business under present firm's names; list of major equipment owned by the company; list of principal personnel who will be involved in the execution of this contract with the experience and qualifications of each person.
6. The Contractor shall provide a project manager that shall be constantly in charge of the VSS installation. The project manager shall be the same person authorized to make decisions and answer questions asked by the Architect and Owner Representatives. The project manager shall also be responsible for system programming, preparation of Operation and Maintenance Manuals, Training, Programs, Schedules and Test Protocols, documentation of system testing, maintenance of Record Drawings and coordination and scheduling of all labor.
7. Provide evidence of site supervisor's qualifications and work history
8. Contractor shall be or have direct relations through their subcontractors, and authorized manufacturer's representatives for all products they furnish or install.
9. Provide documentation that the Contractor and or subcontractor are factory certified to install, program, train and repair all major components or systems to be used in the project.
10. Contractor shall have a local organization capable of providing maintenance and service for the specified system. Facility shall be no more than 100 miles from Owner's site. The security system installation firm shall be capable of providing emergency service on a 24-hour, 7 days a week basis.

1.10 PRODUCT STANDARDS

A. The Contractor will provide all materials, equipment and installation in compliance with the latest applicable standards from ANSI, FCC, ASTM, EIA/TIA, IEEE, NEC, NFPA, NEMA, REA and UL including but not limited to:

1. EIA/TIA-569 Standard, Commercial Building Standard for Telecommunications Pathways and Spaces.
2. EIA/TIA-607 Commercial Building Grounding and Bonding Requirements for Telecommunications
3. ANSI T1.404 (DS3) and CATV Applications
4. National Electrical Code (NEC) (Latest revision and pertinent addendums)
5. National Fire Protection Association (NFPA) Publications (Latest revisions and pertinent addendums)
6. Americans with Disabilities Act (ADA).

7. In the event of any conflicts between documents referenced herein and the contents of this specification, the Contractor shall notify in writing to Engineer of any such occurrences before the purchase of any equipment, materials and/or installation by the Contractor. The Engineer will notify the Contractor of any actions required to resolve these conflicts. Such actions may include but are not limited to: design changes, equipment, materials and/or installation changes. In any event Contractor shall not supersede specifications and standards from the latest NFPA and NEC publications.
8. All equipment, materials and articles incorporated in the work covered by this contract are to be new and unused.
9. The contractor shall provide at installation time the latest current standard model and/or version of all equipment (hardware and software).

1.11 MAINTENANCE SERVICE

A. Furnish service and maintenance of surveillance system for one year from Date of Substantial Completion.

PART 2 - PRODUCTS

2.1 COMPONENTS

A. Outdoor varifocal Camera:

1. Cisco Meraki MV72X

B. PoE Switches. OFOI

2.2 GENERAL

A. Manufacturer's name and product lines are given in the specifications for the purpose of establishing a standard of performance, quality, style and compatibility with the existing network and surveillance video infrastructure.

B. These specifications list approved equipment types and items. In instances where quantities are not detailed, they shall be obtained from the drawings.

C. Alternatives will only be considered if a unique business requirement cannot be met by the Galveston County approved product line, and if specified features are fully supported by the existing infrastructure.

2.3 Video Surveillance System

A. System Description: Provide and install an IP Video Surveillance system including IP cameras, data cabling per division 27, mounts, domes, and any required

components/accessories.

B. General

1. Cameras and support wiring to the common equipment location and video processing equipment in the MDF.
2. Common equipment location with mounting board, support equipment, wire management and power.

C. Video Cameras

1. Camera schedule location, are for reference purposes. Contractor is responsible for coordinating these details with Owner and Security Consultant.

2.4 WIRE AND CABLE

A. Category 6 Per division 27 specifications

PART 3 - EXECUTION

3.1 INSTALLATION

A. This section covers the general requirements for the installation of the security system by the Contractor.

B. Install in accordance with manufacturer's instructions.

C. The Contractor shall be responsible for providing all wire and cable as required for complete and operational system.

D. All cables must be continuous runs from device location to the final point of termination. No mid run cable splices will be allowed.

E. The cable installation techniques shall be such that the mechanical and communications characteristics of the cables are not degraded at the time of installation. Any special environmental requirements for equipment shall be specified.

F. Distribution of the cabling will be accomplished through cable trays, cable runways, conduit raceways, ducts, core holes, extended columns, false half columns and plenums. Cabling shall be run at right angles. Horizontal cable segments will be placed in cable trays and when they leave cable trays will be supported by distribution rings or J-hooks. Where cables converge at equipment room locations, they will be supported by cable runways and distribution rings. All cable placements shall be based on the enclosed drawings.

G. The contractor shall not place security wiring in the same conduit or raceway with wire for electrical power distribution.

H. Connectors to all devices in system shall be protected against moisture. Approval of the method shall not relieve the contractor of full responsibility for proper application and workmanship of the materials in the manner specifically approved. All connector threads shall be treated with an approved silicone lubricant.

I. The Contractor shall be responsible for providing an approved ground and ground bus bars at all newly installed systems insuring proper bonding to telecommunications facilities. The Contractor shall also be responsible for ensuring ground continuity by properly bonding all appropriate cabling, closures, cabinets, service boxes, and framework. All grounds shall consist of a minimum 6 AWG copper wire and shall be supplied from an approved building ground and bonded to the main electrical ground. Contractor must notify the Owner prior to making any changes in submitted system design and/or installation.

J. All exposed J-boxes or enclosures shall have tamper resistant features and hardware. Tamper resistant fasteners to be Tamper-Proof pin-in-hex or pin-in-torx button head screws.

1. Use of common wires for input or output circuits is not allowed.
2. Configure all zones to be normally closed loop with an end of line resistor (EOL) at the most distant point of the zone.
3. The Contractor shall obtain Owner's permission before proceeding with any work necessitating cutting into or through any part of building structures such as girders, beams, concrete or tile floors and partition ceilings.
4. The Contractor shall exercise reasonable care to avoid any damage to Owner's property. Contractor shall be responsible for and repair all damage due to carelessness of workers. Contractor will report to Owner any damage to the building, which may exist or may occur during the occupancy of the quarters.
5. The Contractor shall be responsible for proper electrical grounds.
6. The Contractor shall take necessary steps to ensure that required firefighting apparatus is accessible at all times. Flammable materials shall be kept in suitable places outside the building.
7. The Contractor shall install the materials in accordance with the manufacturers' specifications.
8. The Contractor shall promptly correct all defects for which the Contractor is responsible.
9. The Contractor shall insure that all records and reports, City relations, engineering, metering, inspections, testing, quality or service standards and safety measures comply with standards applicable for the State of Texas.
10. The Contractor shall coordinate all work with Owner's designated representative.
11. The Contractor shall maintain a work area free of debris, trash, empty cable reels, scrap wire, etc., and dispose of such items on a daily basis.
12. All work shall be done in a thorough and conscientious manner according to industry standards and shall be subject to inspection and acceptance.
13. The Contractor shall be certain that all installation work areas are secure and made safe in accordance with Occupational Safety and Health Administration (OSHA) regulations.
14. The installation crew should include at least one installation supervisor, or lead technician, for on-site management of the project at all times.
15. The Contractor shall be responsible for completing a standardized report form

addressing the weekly progress of the installation schedule.

16. The Contractor shall maintain conductor polarity in accordance with industry practices.
17. The Contractor shall provide any necessary screws, anchors, clamps, tie wraps, distribution rings, miscellaneous grounding and support hardware, etc., necessary to facilitate the installation of the distribution system.
18. The Contractor shall be responsible for labeling all cable, distribution devices, enclosures and outlet locations, according to industry standards. Numbering scheme shall be coordinated with Owner's representative before installation.
19. It shall be the responsibility of the Installation Contractor to furnish any special installation equipment or tools necessary to properly complete the installation.
20. The Contractor shall not roll or store cable reels without an appropriate underlay.
21. The Contractor shall not place any distribution cabling alongside power lines, or share the same conduit, channel or sleeve with electrical apparatus.
22. The Contractor shall insure that the maximum pulling tensions of the specified distribution cables are not exceeded at any time during the placement facilities. Failure to follow the appropriate guidelines may require the Contractor to provide additional material and labor necessary to properly rectify the situation. This shall also apply to any and all damages sustained to the cables by the installation Contractor during the implementation.
23. The Contractor shall be responsible for testing all cable prior to the installation of the cable. If the Installation Contractor fails to perform this testing operation, the Installation Contractor shall accept the cable as good and assume all liability for the replacement of the cable should it be found defective at a later date.
24. The Contractor shall plug conduits where cabling has been installed by the Installation Contractor in all equipment rooms and other cable entrance locations with re-enterable duct seal of flame retardant putty.
25. Materials shall be consistent throughout the building. Where two or more units of the same class of equipment are required, these units shall be the product of a single manufacturer and shall be the same product with the same material, model, and manufacturer number.
26. Wiring, materials, and equipment will be delivered and stored in a clean dry space. They will be properly packaged in factory fabricated type containers and protected from damaging fumes, construction debris and traffic until job completion.
27. The wiring, materials, and equipment furnished for this request shall be essentially the standard product of the manufacturer.
28. All wiring, materials, and equipment must be listed and labeled by a nationally recognized testing laboratory.
29. All installation techniques and fixtures shall result in ease of maintenance and ready access to all components for testing measurements. All external screws, nuts, and locking washers shall be stainless steel. No self-tapping screws shall be used unless specifically approved by Owner. All parts shall be made of corrosion resistant material, such as plastic, anodized aluminum or brass. All materials used in installation shall be resistant to fungus growth and moisture deterioration.
30. An inert dielectric material shall separate dissimilar metals apt to corrode through electrolysis under the environmental operating conditions specified.
31. The cable pulling operation shall be performed such that a minimum bending of the cable shall occur in the unreeling and pulling operations. The pulling tension

shall not be allowed to exceed the maximum tension specified by the manufacturer of the cable.

32. Jacketing and insulation shall satisfy the Underwriters Laboratories (UL) listed fire rated cable insulation requirements in plenum areas.
33. Any pulling compound or lubricant used in cable installation shall not deteriorate the conductor or the insulation.
34. Parts and components not specifically mentioned in these specifications, which are required to provide a complete unit, shall be included as a part of the equipment to be furnished.
35. Nothing in the specification shall relieve respondents of system package design responsibility, including, but not limited to, all equipment furnished under this contract. The successful respondent is, in all cases, solely responsible for the performance of the delivered system, and for furnishing complete system documentation for each and every part of the system.

3.2 INTERFACES WITH OTHER PRODUCTS

A. Interface installation of video surveillance with security access systems.

3.3 MANUFACTURER'S FIELD SERVICES

A. Provide the services of manufacturer's technical representative to prepare and start systems and supervise final wiring connections and system adjustments.

3.4 ADJUSTING

A. Adjust manual lens irises to meet lighting conditions.

3.5 DEMONSTRATION

A. Demonstrate system operation and provide one hour of instruction with manufacturer's training personnel.

B. Conduct walking tour of project and briefly describe function, operation, and maintenance of each component.

3.6 WEEKLY CONSTRUCTION MEETING

A. The Security Consultant and/or Owner will hold weekly construction meetings to review the installation schedule. It is mandatory that the Contractor's project manager attend each meeting.

3.7 SITE INSPECTION

A. Continuously verify that the site conditions are in agreement with the Contract

Documents and the security system design. Notify Owner's representative immediately of conditions that affect the performance of the installed system.

B. Coordinate any required work that is not specified in the Contract Documents.

3.8 COORDINATION

A. Adequate conduit and back boxes are provided for the specified system installation.

B. Verify value of end of line supervision module with Owner.

C. Adequate power has been provided for the specified system installation.

1. Verify mounting location of all devices with Owner prior to installation.

3.9 IDENTIFICATION, LABELING AND DOCUMENTATION

A. The Contractor shall label all termination devices, panels, enclosures and equipment rooms. The Contractor will mark each unit with permanently attached markings that will not impair the equipment or present a hazard to maintenance personnel.

B. Place wire identification numbers on each end of all conductors by using sleeve type heat shrinkable markers. Install markers to be readable from left to right or top to bottom. Wire numbers shall be computer printed (Brady TLS2200 with Permasleeve cable marking labels or equivalent). Handwritten labels are not acceptable.

C. Mark all spare conductors.

D. If changes occur prior to acceptance testing altering the documentation previously furnished, the contractor shall formally update and reissue the relevant documentation to the Security Consultant and Owner.

E. Security Consultant and Owner will review all documentation for accuracy and completeness and may reject substandard submittals.

F. The Contractor shall establish and maintain complete system documentation, including documentation procedures, operational information, configuration information, historical records, and drawings. Documentation shall include the following:

1. Floor plan drawings indicating device locations, unique system point numbers with device legends indicating manufacturers and model numbers for each device.
2. The unique system point number of a device shall identify either through the software or hardwire connection, the specific device or group of devices associated with the unique point number in the system.
3. Floor plan drawings indicating conduit and wire routing and junction box locations.
4. Wire routing shall include cable identification and terminal strip numbers.
5. Mounting details for all equipment and hardware.

6. Functional block diagrams for each system.
7. Wiring details showing rack elevations, equipment wiring and terminations and inter-rack wiring.

3.10 SECURITY SYSTEM PROGRAMMING

A. Security System Programming to include commissioning of all controllers, points and related devices.

B. All system programming shall take place in the field to verify Owner-designated zones for all devices. Programming shall be developed with Owner's input and shall not be accepted without Owner's approval.

3.11 WARRANTY

A. The Contractor shall warrant the system for parts and labor for one (1) year. Warranty commences at the time of substantial project completion and acceptance by Owner. Nothing shall be construed to limit this obligation to a shorter period.

B. Warranty service shall be rendered on-site by request of Owner to repair or replace any defective materials, equipment and workmanship without cost to the Owner, unless the Owner has previously given the Contractor a written acceptance of such condition.

C. The Owner shall give prompt notice of the defect(s) either verbally or in writing to Contractor.

D. Perform preventative maintenance during the warranty period, which includes:

1. Quarterly cleaning and inspection of all devices.
2. Quarterly inspection, cleaning and testing of all power supplies/UPS.
3. Quarterly test and replace of batteries as necessary.
4. Clean and vacuum MDF console and rack equipment
5. Service technician performing service / warranty work shall check-in and out for each visit.
6. Provide a written report to Owner documenting any work performed during the warranty period within 24 hours of such event. Report shall detail work performed, equipment repaired or replaced, etc.
7. Provide loaner equipment which is equivalent to the malfunctionING equipment for any equipment not field repairable.
8. Repair or Replacement Service

    a. Repair or replacement service during the warranty period shall be performed 7 days a week, 24 hours a day and with a 4-hour response time.
    b. If the Contractor cannot restore system operation during the warranty period within 2 business days of the system failure, the Owner reserves the right to require the Contractor to provide on-site manufacturer's service technicians at no additional cost.
    c. The Owner reserves the right to expand or add to the system during the warranty period using firm(s) other than the contractor for such expansion

without affecting the Contractor's responsibilities, provided the expansion is performed by an authorized dealer for the affected equipment.

d. On-line software and hardware service shall be provided and shall be password protected and controlled by the Owner.

3.12 TECHNICAL VERIFICATION SESSION

A. A complete product manuals and preliminary as-built drawings shall be delivered to the owner one week prior to the training sessions.

B. Technical verification and walk through shall consist of:

1. Technical explanation sufficiently thorough that: staff personnel shall be able to identify and trace circuits, analyze malfunctions and make changes as necessary to maintain system operation.

2. Provide printed reference material for each trainee that documents and explains in technical terms:

a. System block diagram with technical features

b. Method and record of end-to-end testing

c. Review of as-built drawings.

d. Q & A session.

3.13 SUBSTANTIAL COMPLETION

A. Work must meet the following requirements to qualify for the Owner's consideration of Substantial Completion:

1. All cameras and monitoring devices shall be fully installed, tested and fully operational
2. Video cameras powered and focused.
3. End to end testing reports produced
4. Technical verification process complete.
5. Owner may utilize the system for its designed intent.
6. Contractor will provide a list of remaining work items and approximate completion date.
7. Contractor will certify in writing that all remaining work is minor in nature and will be completed in less than 30 days.

3.14 TESTING REQUIREMENTS

A. The contractor shall perform sample tests in the presence of the Security Consultant and Owner. Performing the testing procedures specified herein assures that the communication cabling and system electronics meets the performance characteristics

specified. All testing shall comply with EIA/TIA Standards and that of the equipment manufacturers. If testing indicates that the performance characteristics are not met, the test shall be failed test and any other test that may be affected by the modification and/or repair shall be rerun and verified.

B. Test equipment will be provided by the contractor to test and to certify the 100% operational condition of all materials and equipment.

C. The Vendor shall prepare and submit all test procedures and data forms for the pre-installation, post installation and subsystem test to Owner. The test procedures shall have Owner approval before the tests.

3.15 SYSTEM CHECK OUT AND VERIFICATION

A. Commission all security devices from field up to and including the head-end.

B. Contractor supplied "As Built" Drawings shall show security conduit routing and cable labeling.

C. Review all as built and testing documentation with Owner. Revise and reissue as required.

D. Video camera image as received at the head-end is noise free, focused and field of view of view is optimized for intended content.

3.16 ACCEPTANCE OF SYSTEMS

A. Each area of construction completed and submitted as complete shall meet the following criteria under testing:

1. System must meet all specifications as described in these instructions.
2. Operational prints, manuals, signal logs, and as built prints must be furnished.
3. Visual testing and signal verification will be conducted at random locations to determine that equipment performs satisfactorily.
4. Specifications set forth for construction of the system have been devised in order to insure system compatibility and performance. Compliance to these specifications will be determined during periodic observances of construction. Repeated failure to comply with the specification will be considered before the initial acceptance phase of the plant commences.
5. Within ten days receipt of the final acceptance notice, the Owner's representatives shall schedule and perform the final inspection. When the work is found acceptable under the contract documents and the contract is fully performed, the project will be declared complete.

END OF SECTION 28 23 00

SECTION 28 26 00 - ELECTRONIC PERSONAL PROTECTION SYSTEMS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Emergency Call Stanchions

B. Control equipment.

C. Cable and accessories.

1.2 RELATED SECTIONS

A. Section 08 71 00 - Door Hardware.

B. Section 11 12 00 - Parking Control Equipment.

C. Section 14 20 10 - Passenger Elevators.

D. Section 26 05 19 - Low-Voltage Electrical Power Conductors and Cables (600 V and Less).

E. Section 28 05 00 - Common Work Results for Electronic Safety and Security

F. Section 28 05 26 - Grounding and Bonding for Electronic Safety and Security.

G. Section 28 05 28 - Pathways for Electronic Safety and Security.

H. Section 28 05 53 - Identification for Electronic Safety and Security.

I. Section 28 06 00 - Testing for Electronic Safety and Security.

J. Section 28 13 00 – Access Control.

K. Section 28 16 00 – Intrusion Detection.

L. Section 28 23 00 – Video Surveillance

M. Division 27 00 00 – Communications

N. Galveston County Design Guideline and Standards Security System Standards (latest edition)

O. See Division 26 for all information relating to the fire alarm system and required relay interface to release emergency delay exit doors. The fire alarm integrator shall provide the control relays as required.

1. See Division 16 for all specifications governing the performance of work associated with the installation of raceway, system junction and pull boxes and device rough-in boxes for

all work shown in the Access Control System refer to the SC series security drawings.

1.3 EMERGENCY COMMUNICATION SYSTEM

A. Functional Requirements

1. The Emergency Communication System (ECS) shall consist of a two-button hands-free direct dial communications unit. There are two different types of units one for wall mounting and one standalone exterior mounting. For ease of identifying these units the wall mount unit shall be designated as a Call Box (CB) and the stanchion mounted exterior unit shall be designated as a Call Tower (CT).
2. Each CB/CT shall be equipped with a red push button labeled POLICE and a black push button Labeled INFO. The Police push button shall be programmed to dial the campus police 911 line for emergencies. The INFO button shall program to dial a number determined for general information requests.
3. The Call Tower shall consist of the Call Box faceplate mounted in a free-standing vandal resistant tower with a blue strobe light mounted on its top. The blue strobe light shall function the same as the Call Box light. The faceplate shall be continuously illuminated by LEDs flush mounted in the tower above the faceplate. The Call Tower shall meet the following minimum specifications:

   a. Dimensions - 12" W X 10" D X 110" H w/ 2" radius corners.
   b. Weight - 450 Lbs.
   c. Construction - .025" steel w/multi-coat rust inhibitive coating
   d. Strobe - 1.5 million candlepower, 70 flashes per minute.
   e. Blue light - 7 Watt high efficiency, 10,000 hour compact fluorescent.
   f. Faceplate - Ultra bright LEDs, 100,000 Hour lifetime.
   g. 120VAC, 5 Amp minimum circuit
   h. Lettering - 3.25" high reflective white letters.
   i. Compliance - CSA Certified to UL Standard 60950.

5. Camera equipped Call Towers shall be the same tower assembly as the standard unit with the addition of an arm that extends above the tower to support a pendent mounted PTZ dome camera and the blue light.

   a. Each push button shall be provided with a momentary contact, normally open dry contact that shall be wired to an access control panel alarm input to facilitate camera selection through the ACID / DVMS integration.
   b. Each CB shall have a dedicated PBX extension to allow the individual telephone unit to be uniquely identified by the answering party. Actual programming shall be determined by the Owner.
   c. Call Towers shall have an analog adapter to allow a two-way communication via a VOIP system with the campus police office.
   d. All call towers shall be equipped with an IP relay interface to facilitate transmission of the POLICE button alarm contacts over the IP network to the designated equipment room where the IP relay output contact shall be connected to an access control panel alarm input.
   e. Call Towers shall be equipped with a media converter to convert all electrical signals to optical signals for transmission via fiber optic cable the designated equipment room A rack mounted version of the media converter shall reconvert the signals for connection to the Ethernet.

C. Conduit, cable tray and back boxes for this system shall be furnished and installed by the

electrical contractor under the supervision of the security contractor.

PART 2 - PRODUCTS

2.1 MATERIALS LIST

A. Code Blue Call Tower - CB1-e - Interactive Voice Communication Unit

B. Code Blue Call Tower – CB1-wb – Solar/Cellular Interactive Voice Communication Unit

C. Code Blue Wall Mounted Call Box – CB2-e - Interactive Voice Communication Unit

2.2 FINISH

A. The unit housing shall be fabricated of non-magnetic # 304 stainless steel and shall be power coated after fabrication. The finish shall be uniform and free of visible defects.

2.3 GRAPHICS

A. The graphics shall be cut from a durable engineering grade reflective vinyl for high visibility and legibility.

B. The standard graphics text shall be “Emergency”, “Assistance”, or “Courtesy”, and placed on two sides of wall unit. Standard colors shall be white, blue and black. Customized graphics and colors shall also be available.

PART 3 - EXECUTION

3.1 MOUNTING

A. The column shall include four 5/8” x 16” J-bolts for mounting into a 20” X 20” X 3' concrete foundation. J-bolts shall protrude approximately 2 ½” inches from surface of foundation.

3.2 ELECTRICAL

A. The communication device shall require no external power. The phone line, PBX extension, or a wireless communication interface shall power it. The requirements shall be 30 ma loop current at the unit, with a line resistance of less than 700 OHMS. A 22 to 26 shielded twisted pair cable shall be used. Longer cable runs shall require a heavier gauge cable. Verify manufacture requirements.

B. The unit shall require 120 VAC and draw a maximum of 3 amperes under normal operation, 4 amps with heater.

C. All lamps and fixtures shall be UL. listed. All electrical components shall be hard wired and concealed within the column in aluminum flex conduit. All wiring and electrical fixtures comply with the standards of the National Electrical Code, UL.

3.3 WARRANTY

A. Equipment shall be warranted against any defects in material and workmanship, under normal use, for a period of two years from date of purchase. In the event system is found by manufacturer to be defective within the warranty period, manufacturer shall repair and/or replace any defective parts, provided the equipment is returned to manufacturer.

END OF SECTION

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SECTION 28 31 11 - DIGITAL, ADDRESSABLE FIRE-ALARM SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Fire-alarm control unit.
2. Manual fire-alarm boxes.
3. System smoke detectors.
4. Heat detectors.
5. Notification appliances.
6. Device guards.
7. Remote annunciator.
8. Addressable interface device.
9. Digital alarm communicator transmitter.
10. System printer.

1.3 DEFINITIONS

A. EMT: Electrical Metallic Tubing.

B. FACP: Fire Alarm Control Panel.

C. HLI: High Level Interface.

D. NICET: National Institute for Certification in Engineering Technologies.

E. PC: Personal computer.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product, including furnished options and accessories.

1. Include construction details, material descriptions, dimensions, profiles, and finishes.
2. Include rated capacities, operating characteristics, and electrical characteristics.

B. Shop Drawings: For fire-alarm system.

1. Comply with recommendations and requirements in the "Documentation" section of the "Fundamentals" chapter in NFPA 72.
2. Include plans, elevations, sections, details, and attachments to other work.

3. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and locations. Indicate conductor sizes, indicate termination locations and requirements, and distinguish between factory and field wiring.
4. Detail assembly and support requirements.
5. Include voltage drop calculations for notification-appliance circuits.
6. Include battery-size calculations.
7. Include input/output matrix.
8. Include statement from manufacturer that all equipment and components have been tested as a system and meet all requirements in this Specification and in NFPA 72.
9. Include performance parameters and installation details for each detector.
10. Verify that each duct detector is listed for complete range of air velocity, temperature, and humidity possible when air-handling system is operating.
11. Provide program report showing that air-sampling detector pipe layout balances pneumatically within the airflow range of the air-sampling detector.
12. Include plans, sections, and elevations of heating, ventilating, and air-conditioning ducts, drawn to scale; coordinate location of duct smoke detectors and access to them.

    a. Show critical dimensions that relate to placement and support of sampling tubes, detector housing, and remote status and alarm indicators.
    b. Show field wiring required for HVAC unit shutdown on alarm.
    c. Locate detectors according to manufacturer's written recommendations.
    d. Show air-sampling detector pipe routing.

13. Include floor plans to indicate final outlet locations showing address of each addressable device. Show size and route of cable and conduits and point-to-point wiring diagrams.

C. General Submittal Requirements:

1. Submittals shall be approved by authorities having jurisdiction prior to submitting them to Architect.

2. Shop Drawings shall be prepared by persons with the following qualifications:

    a. Trained and certified by manufacturer in fire-alarm system design.
    b. NICET-certified, fire-alarm technician; Level IV minimum.
    c. Licensed or certified by authorities having jurisdiction.

D. Delegated-Design Submittal: For notification appliances and smoke and heat detectors, in addition to submittals listed above, indicate compliance with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1. Drawings showing the location of each notification appliance and smoke and heat detector, ratings of each, and installation details as needed to comply with listing conditions of the device.
2. Design Calculations: Calculate requirements for selecting the spacing and sensitivity of detection, complying with NFPA 72. Calculate spacing and intensities for strobe signals and sound-pressure levels for audible appliances.
3. Indicate audible appliances required to produce square wave signal per NFPA 72.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Field quality-control reports.

1.6 Sample Warranty: For special warranty.

1.7 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For fire-alarm systems and components to include in emergency, operation, and maintenance manuals.

1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:

a. Comply with the "Records" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72.
b. Provide "Fire Alarm and Emergency Communications System Record of Completion Documents" according to the "Completion Documents" Article in the "Documentation" section of the "Fundamentals" chapter in NFPA 72.
c. Complete wiring diagrams showing connections between all devices and equipment. Each conductor shall be numbered at every junction point with indication of origination and termination points.
d. Riser diagram.
e. Device addresses.
f. Air-sampling system sample port locations and modeling program report showing layout meets performance criteria.
g. Record copy of site-specific software.
h. Provide "Inspection and Testing Form" according to the "Inspection, Testing and Maintenance" chapter in NFPA 72, and include the following:

1) Equipment tested.
2) Frequency of testing of installed components.
3) Frequency of inspection of installed components.
4) Requirements and recommendations related to results of maintenance.
5) Manufacturer's user training manuals.

i. Manufacturer's required maintenance related to system warranty requirements.
j. Abbreviated operating instructions for mounting at fire-alarm control unit and each annunciator unit.

B. Software and Firmware Operational Documentation:

1. Software operating and upgrade manuals.
2. Program Software Backup: On magnetic media or compact disk, complete with data files.
3. Device address list.
4. Printout of software application and graphic screens.

1.8 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Lamps for Remote Indicating Lamp Units: Quantity equal to 10 percent of amount installed, but no fewer than one unit.

2. Lamps for Strobe Units: Quantity equal to 10 percent of amount installed, but no fewer than one unit.
3. Smoke Detectors and Fire Detectors: Quantity equal to 10 percent of amount of each type installed, but no fewer than one unit of each type.
4. Detector Bases: Quantity equal to two percent of amount of each type installed, but no fewer than one unit of each type.
5. Keys and Tools: One extra set for access to locked or tamperproof components.
6. Audible and Visual Notification Appliances: One of each type installed.
7. Fuses: Two of each type installed in the system. Provide in a box or cabinet with compartments marked with fuse types and sizes.

1.9 QUALITY ASSURANCE

A. Installer Qualifications: Personnel shall be trained and certified by manufacturer for installation of units required for this Project.

B. Installer Qualifications: Installation shall be by personnel certified by NICET as fire-alarm Level III technician.

C. NFPA Certification: Obtain certification according to NFPA 72 by an NRTL (nationally recognized testing laboratory).

D. NFPA Certification: Obtain certification according to NFPA 72 by a UL-listed alarm company.

E. NFPA Certification: Obtain certification according to NFPA 72 in the form of a placard by an FM Global-approved alarm company.

1.10 PROJECT CONDITIONS

A. Perform a full test of the existing system prior to starting work. Document any equipment or components not functioning as designed.

B. Use of Devices during Construction: Protect devices during construction unless devices are placed in service to protect the facility during construction.

1.11 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace fire-alarm system equipment and components that fail in materials or workmanship within specified warranty period.

1. Warranty Extent: All equipment and components not covered in the Maintenance Service Agreement.
2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

A. Source Limitations for Fire-Alarm System and Components: Components shall be compatible with, and operate as an extension of, existing system. Provide system manufacturer's certification that all components provided have been tested as, and will operate as, a system.

B. Noncoded, UL-certified addressable system, with multiplexed signal transmission and horn/strobe evacuation.

C. Automatic sensitivity control of certain smoke detectors.

D. All components provided shall be listed for use with the selected system.

E. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.2 SYSTEMS OPERATIONAL DESCRIPTION

A. Fire-alarm signal initiation shall be by one or more of the following devices[**and systems**]:

1. Manual stations.
2. Heat detectors.
3. Smoke detectors.
4. Duct smoke detectors.
5. Automatic sprinkler system water flow.
6. Fire-extinguishing system operation.

B. Fire-alarm signal shall initiate the following actions:

1. Continuously operate alarm notification appliances.
2. Identify alarm and specific initiating device at fire-alarm control unit and remote annunciators.
3. Transmit an alarm signal to the remote alarm receiving station.
4. Activate alarm communication system.
5. Switch heating, ventilating, and air-conditioning equipment controls to fire-alarm mode.
6. Close smoke dampers in air ducts of designated air-conditioning duct systems.
7. Record events in the system memory.
8. Record events by the system printer.
9. Indicate device in alarm on the graphic annunciator.

C. Supervisory signal initiation shall be by one or more of the following devices and actions:

1. Valve supervisory switch.
2. High- or low-air-pressure switch of a dry-pipe or preaction sprinkler system.
3. User disabling of zones or individual devices.
4. Loss of communication with any panel on the network.

D. System trouble signal initiation shall be by one or more of the following devices and actions:

1. Open circuits, shorts, and grounds in designated circuits.

2. Opening, tampering with, or removing alarm-initiating and supervisory signal-initiating devices.
3. Loss of communication with any addressable sensor, input module, relay, control module, remote annunciator, printer interface, or Ethernet module.
4. Loss of primary power at fire-alarm control unit.
5. Ground or a single break in internal circuits of fire-alarm control unit.
6. Abnormal ac voltage at fire-alarm control unit.
7. Break in standby battery circuitry.
8. Failure of battery charging.
9. Abnormal position of any switch at fire-alarm control unit or annunciator.

E. System Supervisory Signal Actions:

1. Initiate notification appliances.
2. Identify specific device initiating the event at fire-alarm control unit and remote annunciators.
3. Record the event on system printer.
4. After a time delay of 200 seconds, transmit a trouble or supervisory signal to the remote alarm receiving station.
5. Transmit system status to building management system.
6. Display system status on graphic annunciator.

2.3 FIRE-ALARM CONTROL UNIT

A. General Requirements for Fire-Alarm Control Unit:

1. Field-programmable, microprocessor-based, modular, power-limited design with electronic modules, complying with UL 864.

   a. System software and programs shall be held in nonvolatile flash, electrically erasable, programmable, read-only memory, retaining the information through failure of primary and secondary power supplies.
   b. Include a real-time clock for time annotation of events on the event recorder and printer.
   c. Provide communication between the FACP and remote circuit interface panels, annunciators, and displays.
   d. The FACP shall be listed for connection to a central-station signaling system service.
   e. Provide nonvolatile memory for system database, logic, and operating system and event history. The system shall require no manual input to initialize in the event of a complete power down condition. The FACP shall provide a minimum 500-event history log.

2. Addressable Initiation Device Circuits: The FACP shall indicate which communication zones have been silenced and shall provide selective silencing of alarm notification appliance by building communication zone.
3. Addressable Control Circuits for Operation of Notification Appliances and Mechanical Equipment: The FACP shall be listed for releasing service.

B. Alphanumeric Display and System Controls: Arranged for interface between human operator at fire-alarm control unit and addressable system components including annunciation and supervision. Display alarm, supervisory, and component status messages and the programming and control menu.

1. Annunciator and Display: Liquid-crystal type, 80 characters, minimum.
2. Keypad: Arranged to permit entry and execution of programming, display, and control commands.

C. Alphanumeric Display and System Controls: Arranged for interface between human operator at fire-alarm control unit and addressable system components including annunciation and supervision. Display alarm, supervisory, and component status messages and the programming and control menu.

1. Annunciator and Display: Liquid-crystal type, two line(s) of 40 characters, minimum.
2. Keypad: Arranged to permit entry and execution of programming, display, and control commands.

D. Initiating-Device, Notification-Appliance, and Signaling-Line Circuits:

1. Pathway Class Designations: NFPA 72, Class A.
2. Pathway Survivability: Level 0.
3. Install no more than 100 addressable devices on each signaling-line circuit.
4. Serial Interfaces:

a. One dedicated RS 485 port for central-station operation using point ID DACT.
b. One RS 485 port for remote annunciators, Ethernet module, or multi-interface module (printer port).
c. One USB port for PC configuration.
d. One RS 232 port for VESDA HLI connection.
e. One RS 232 port for voice evacuation interface.

E. Smoke-Alarm Verification:

1. Initiate audible and visible indication of an "alarm-verification" signal at fire-alarm control unit.
2. Activate an approved "alarm-verification" sequence at fire-alarm control unit and detector.
3. Record events by the system printer.
4. Sound general alarm if the alarm is verified.
5. Cancel fire-alarm control unit indication and system reset if the alarm is not verified.

F. Notification-Appliance Circuit:

1. Audible appliances shall sound in a three-pulse temporal pattern, as defined in NFPA 72.
2. Visual alarm appliances shall flash in synchronization where multiple appliances are in the same field of view, as defined in NFPA 72.

G. Remote Smoke-Detector Sensitivity Adjustment: Controls shall select specific addressable smoke detectors for adjustment, display their current status and sensitivity settings, and change those settings. Allow controls to be used to program repetitive, time-scheduled, and automated changes in sensitivity of specific detector groups. Record sensitivity adjustments and sensitivity-adjustment schedule changes in system memory, and print out the final adjusted values on system printer.

H. Transmission to Remote Alarm Receiving Station: Automatically transmit alarm, supervisory, and trouble signals to a remote alarm station.

I. Printout of Events: On receipt of signal, print alarm, supervisory, and trouble events. Identify zone, device, and function. Include type of signal (alarm, supervisory, or trouble) and date and

time of occurrence. Differentiate alarm signals from all other printed indications. Also print system reset event, including same information for device, location, date, and time. Commands initiate the printing of a list of existing alarm, supervisory, and trouble conditions in the system and a historical log of events.

J. Primary Power: 24-V dc obtained from 120-V ac service and a power-supply module. Initiating devices, notification appliances, signaling lines, trouble signals, and supervisory signals shall be powered by 24-V dc source.

1. Alarm current draw of entire fire-alarm system shall not exceed 80 percent of the power-supply module rating.

K. Secondary Power: 24-V dc supply system with batteries, automatic battery charger, and automatic transfer switch.

1. Batteries: Sealed lead calcium.

L. Instructions: Computer printout or typewritten instruction card mounted behind a plastic or glass cover in a stainless-steel or aluminum frame. Include interpretation and describe appropriate response for displays and signals. Briefly describe the functional operation of the system under normal, alarm, and trouble conditions.

2.4 MANUAL FIRE-ALARM BOXES

A. General Requirements for Manual Fire-Alarm Boxes: Comply with UL 38. Boxes shall be finished in red with molded, raised-letter operating instructions in contrasting color; shall show visible indication of operation; and shall be mounted on recessed outlet box. If indicated as surface mounted, provide manufacturer's surface back box.

1. Double-action mechanism requiring two actions to initiate an alarm, pull-lever type; with integral addressable module arranged to communicate manual-station status (normal, alarm, or trouble) to fire-alarm control unit.
2. Station Reset: Key- or wrench-operated switch.

2.5 SYSTEM SMOKE DETECTORS

A. General Requirements for System Smoke Detectors:

1. Comply with UL 268; operating at 24-V dc, nominal.
2. Detectors shall be two-wire type.
3. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.
4. Base Mounting: Detector and associated electronic components shall be mounted in a twist-lock module that connects to a fixed base. Provide terminals in the fixed base for connection to building wiring.
5. Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore them to normal operation.
6. Integral Visual-Indicating Light: LED type, indicating detector has operated.
7. Remote Control: Unless otherwise indicated, detectors shall be digital-addressable type, individually monitored at fire-alarm control unit for calibration, sensitivity, and alarm condition and individually adjustable for sensitivity by fire-alarm control unit.

a. Rate-of-rise temperature characteristic of combination smoke- and heat-detection units shall be selectable at fire-alarm control unit for 15 or 20 deg F (8 or 11 deg C) per minute.
b. Fixed-temperature sensing characteristic of combination smoke- and heat-detection units shall be independent of rate-of-rise sensing and shall be settable at fire-alarm control unit to operate at 135 or 155 deg F (57 or 68 deg C).
c. Multiple levels of detection sensitivity for each sensor.
d. Sensitivity levels based on time of day.

B. Photoelectric Smoke Detectors:

1. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.
2. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:

a. Primary status.
b. Device type.
c. Present average value.
d. Present sensitivity selected.
e. Sensor range (normal, dirty, etc.).

C. Ionization Smoke Detector:

1. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.
2. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:

a. Primary status.
b. Device type.
c. Present average value.
d. Present sensitivity selected.
e. Sensor range (normal, dirty, etc.).

D. Duct Smoke Detectors: Photoelectric type complying with UL 268A.

1. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.
2. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:

a. Primary status.
b. Device type.
c. Present average value.
d. Present sensitivity selected.
e. Sensor range (normal, dirty, etc.).

3. Weatherproof Duct Housing Enclosure: NEMA 250, Type 4X; NRTL listed for use with the supplied detector for smoke detection in HVAC system ducts.
4. Each sensor shall have multiple levels of detection sensitivity.
5. Sampling Tubes: Design and dimensions as recommended by manufacturer for specific duct size, air velocity, and installation conditions where applied.
6. Relay Fan Shutdown: Fully programmable relay rated to interrupt fan motor-control circuit.

2.6 MULTICRITERIA DETECTORS

A. Mounting: Twist-lock base interchangeable with smoke-detector bases.

B. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.

C. Automatically adjusts its sensitivity by means of drift compensation and smoothing algorithms. The detector shall send trouble alarm if it is incapable of compensating for existing conditions.

D. Test button tests all sensors in the detector.

E. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:

1. Primary status.
2. Device type.
3. Present sensitivity selected.
4. Sensor range (normal, dirty, etc.).

F. Sensors: The detector shall be comprised of four sensing elements including a smoke sensor, a carbon monoxide sensor, an infrared sensor, and a heat sensor.

1. Smoke sensor shall be photoelectric type as described in "System Smoke Detectors" Article.
2. Carbon monoxide sensor shall be as described in "Carbon Monoxide Detectors" Article.
3. Heat sensor shall be as described in "Heat Detectors" Article.
4. Each sensor shall be separately listed according to requirements for its detector type.

2.7 HEAT DETECTORS

A. General Requirements for Heat Detectors: Comply with UL 521.

1. Temperature sensors shall test for and communicate the sensitivity range of the device.

B. Heat Detector, Combination Type: Actuated by either a fixed temperature of 135 deg F (57 deg C) or a rate of rise that exceeds 15 deg F (8 deg C) per minute unless otherwise indicated.

1. Mounting: Twist-lock base interchangeable with smoke-detector bases.
2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.

C. Heat Detector, Fixed-Temperature Type: Actuated by temperature that exceeds a fixed temperature of 190 deg F (88 deg C).

1. Mounting: Twist-lock base interchangeable with smoke-detector bases.
2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.

D. Continuous Linear Heat-Detector System:

1. Detector Cable: Rated detection temperature 155 deg F (68 deg C. Listed for "regular" service and a standard environment. Cable includes two steel actuator wires twisted together with spring pressure, wrapped with protective tape, and finished with PVC outer

sheath. Each actuator wire is insulated with heat-sensitive material that reacts with heat to allow the cable twist pressure to short circuit wires at the location of elevated temperature.

2. Control Unit: Two-zone or multizone unit as indicated. Provide same system power supply, supervision, and alarm features as specified for fire-alarm control unit.
3. Signals to Fire-Alarm Control Unit: Any type of local system trouble shall be reported to fire-alarm control unit as a composite "trouble" signal. Alarms on each detection zone shall be individually reported to central fire-alarm control unit as separately identified zones.
4. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.

E. Detector:

1. Detector, Filter, Aspirator, and Relays: Housed in a mounting box and arranged in such a way that air is drawn from the detection area and a sample passed through the dual-stage filter and detector by the aspirator.
2. Obscuration Sensitivity Range: 0.005 - 6 percent obs/ft.
3. Four independent, field-programmable, smoke-alarm thresholds per sensor pipe and a programmable scan time delay. The threshold set points shall be programmable.

    a. The four alarm thresholds may be used as follows:

        1) Alarm Level 1 (Alert): Activate a visual and an audible supervisory alarm.
        2) Alarm Level 2 (Action): Activate shutdown of electrical/HVAC equipment and activate a visual and an audible supervisory alarm.
        3) Alarm Level 3 (Fire 1): Activate building alarm systems and initiate call to fire response unit.
        4) Alarm Level 4 (Fire 2): Activate suppression system or other countermeasures.

    b. Final Detection System Settings: Approved by **Architect**] [**Owner**].
    c. Initial Detection Alarm Settings:

        1) Alarm Level 1 (Alert): 0.08 percent obs/ft.
        2) Alarm Level 2 (Action): 1.0 percent obs/ft.
        3) Alarm Level 3 (Fire 1): 2.0 percent obs/ft.
        4) Alarm Level 4 (Fire 2): 4.0 percent obs/ft.

4. Power Supply:

    a. Regulated 24-V dc, monitored by the fire-alarm control unit, with battery backup.
    b. Battery backup shall provide 24 hours' standby, followed by 30 minutes at maximum connected load.

5. Detector shall also transmit the following faults:

    a. Detector.
    b. Filter.
    c. System.
    d. Zone.
    e. Network.
    f. Power.

6. Provide four in-line sample pipe inlets that shall contain a flow sensor for each pipe inlet. The detector shall be capable of identifying the pipe from which smoke was detected.
7. Aspirator: Air pump capable of allowing for multiple sampling pipe runs up to 650 feet (200 m) in total, (four pipe runs per detector) with a transport time of less than 120 seconds from the farthest sample port.
8. Provide software-programmable relays rated at 2 A at 30-V dc for alarm and fault conditions.
9. Provide built-in event and smoke logging; store smoke levels, alarm conditions, operator actions, and faults with date and time of each event. Each detector (zone) shall be capable of storing up to 18,000 events.
10. Urgent and Minor Faults. Minor faults shall be designated as trouble alarms. Urgent faults, which indicate the unit may not be able to detect smoke, shall be designated as supervisory alarms.

F. Displays:

1. Include display module within each detector.
2. Each display shall provide the following features at a minimum:

    a. A bar-graph display.
    b. Four independent, high-intensity alarm indicators (Alert, Action, Fire 1, and Fire 2), corresponding to the four alarm thresholds of the indicated sector.
    c. Alarm threshold indicators for Alert, Action, and Fire 1.
    d. LED indication that the first alarm sector is established.
    e. Detector fault and airflow fault indicators.
    f. LED indicators shall be provided for faults originating in the particular zone (Zone Fault), faults produced by the overall smoke-detection system, and faults resulting from network wiring errors (Network Fault).
    g. Minor and urgent LED fault indicators.

G. Sampling Tubes:

1. Smooth bore with a nominal 1-inch (25-mm) OD and a 7/8-inch (21-mm) ID. Sampling pipe with between 5/8- and 1-inch (15- and 25-mm) ID can be used in specifically approved locations when recommended by manufacturer.
2. Pipe Material: CPVC and complying with UL 1887, "Safety Fire Test of Plastic Sprinkler Pipe for Visible Flame and Smoke Characteristics."
3. Joints in the sampling pipe shall be airtight. Use solvent cement approved by the pipe manufacturer on all joints except at entry to the detector.
4. Identify piping with labels reading: "Aspirating Smoke Detector Pipe - Do Not Paint or Disturb" along its entire length at regular intervals according to NFPA 72.
5. Support pipes at not more than 60-inch (1520-mm) centers.
6. Fit end of each trunk or branch pipe with an end cap and drilled with a hole appropriately sized to achieve the performance as specified and as calculated by the system design.

H. Sampling Holes:

1. Sampling holes of 5/64 inch (2 mm), or other sized holes per manufacturer's written instructions, shall be separated by not more than the maximum distance allowable for conventional smoke detectors. Intervals may vary according to calculations.
2. Follow manufacturer's written recommendations to determine the number and spacing of sampling points and the distance from sampling points to ceiling or roof structure and to forced ventilation systems.
3. Each sampling point shall be identified by an applied decal.

2.8 NOTIFICATION APPLIANCES

A. General Requirements for Notification Appliances: Individually addressed, connected to a signaling-line circuit, equipped for mounting as indicated, and with screw terminals for system connections.

B. General Requirements for Notification Appliances: Connected to notification-appliance signal circuits, zoned as indicated, equipped for mounting as indicated, and with screw terminals for system connections.

1. Combination Devices: Factory-integrated audible and visible devices in a single-mounting assembly, equipped for mounting as indicated, and with screw terminals for system connections.

C. Horns: Electric-vibrating-polarized type, 24-V dc; with provision for housing the operating mechanism behind a grille. Comply with UL 464. Horns shall produce a sound-pressure level of 90 dBA, measured 10 feet (3 m) from the horn, using the coded signal prescribed in UL 464 test protocol.

D. Visible Notification Appliances: Xenon strobe lights complying with UL 1971, with clear or nominal white polycarbonate lens mounted on an aluminum faceplate. The word "FIRE" is engraved in minimum 1-inch- (25-mm-) high letters on the lens.

1. Rated Light Output:

   a. 15/30/75/110 cd, selectable in the field.

2. Mounting: Wall mounted unless otherwise indicated.
3. For units with guards to prevent physical damage, light output ratings shall be determined with guards in place.
4. Flashing shall be in a temporal pattern, synchronized with other units.
5. Strobe Leads: Factory connected to screw terminals.
6. Mounting Faceplate: Factory finished, white.

2.9 REMOTE ANNUNCIATOR

A. Description: Annunciator functions shall match those of fire-alarm control unit for alarm, supervisory, and trouble indications. Manual switching functions shall match those of fire-alarm control unit, including acknowledging, silencing, resetting, and testing.

1. Mounting: Flush cabinet, NEMA 250, Type 1.

B. Display Type and Functional Performance: Alphanumeric display and LED indicating lights shall match those of fire-alarm control unit. Provide controls to acknowledge, silence, reset, and test functions for alarm, supervisory, and trouble signals.

2.10 ADDRESSABLE INTERFACE DEVICE

A. General:

1. Include address-setting means on the module.
2. Store an internal identifying code for control panel use to identify the module type.
3. Listed for controlling HVAC fan motor controllers.

B. Monitor Module: Microelectronic module providing a system address for alarm-initiating devices for wired applications with normally open contacts.

C. Control Module:

1. Operate notification devices.
2. Operate solenoids for use in sprinkler service.

2.11 DIGITAL ALARM COMMUNICATOR TRANSMITTER

A. Digital alarm communicator transmitter shall be acceptable to the remote central station and shall comply with UL 632.

B. Functional Performance: Unit shall receive an alarm, supervisory, or trouble signal from fire-alarm control unit and automatically capture [**one**] [**two**] telephone line(s) and dial a preset number for a remote central station. When contact is made with central station(s), signals shall be transmitted. If service on either line is interrupted for longer than 45 seconds, transmitter shall initiate a local trouble signal and transmit the signal indicating loss of telephone line to the remote alarm receiving station over the remaining line. Transmitter shall automatically report telephone service restoration to the central station. If service is lost on both telephone lines, transmitter shall initiate the local trouble signal.

C. Local functions and display at the digital alarm communicator transmitter shall include the following:

1. Verification that both telephone lines are available.
2. Programming device.
3. LED display.
4. Manual test report function and manual transmission clear indication.
5. Communications failure with the central station or fire-alarm control unit.

D. Digital data transmission shall include the following:

1. Address of the alarm-initiating device.
2. Address of the supervisory signal.
3. Address of the trouble-initiating device.
4. Loss of ac supply.
5. Loss of power.
6. Low battery.
7. Abnormal test signal.
8. Communication bus failure.

E. Secondary Power: Integral rechargeable battery and automatic charger.

F. Self-Test: Conducted automatically every 24 hours with report transmitted to central station.

2.12 DEVICE GUARDS

A. Description: Welded wire mesh of size and shape for the manual station, smoke detector, gong, or other device requiring protection.

1. Factory fabricated and furnished by device manufacturer.
2. Finish: Paint of color to match the protected device.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions for compliance with requirements for ventilation, temperature, humidity, and other conditions affecting performance of the Work.

1. Verify that manufacturer's written instructions for environmental conditions have been permanently established in spaces where equipment and wiring are installed, before installation begins.

B. Examine roughing-in for electrical connections to verify actual locations of connections before installation.

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

3.2 EQUIPMENT INSTALLATION

A. Comply with NFPA 72, NFPA 101, and requirements of authorities having jurisdiction for installation and testing of fire-alarm equipment. Install all electrical wiring to comply with requirements in NFPA 70 including, but not limited to, Article 760, "Fire Alarm Systems."

1. Devices placed in service before all other trades have completed cleanup shall be replaced.
2. Devices installed but not yet placed in service shall be protected from construction dust, debris, dirt, moisture, and damage according to manufacturer's written storage instructions.

B. Install wall-mounted equipment, with tops of cabinets not more than 78 inches (1980 mm) above the finished floor.

C. Manual Fire-Alarm Boxes:

1. Install manual fire-alarm box in the normal path of egress within 60 inches (1520 mm) of the exit doorway.
2. Mount manual fire-alarm box on a background of a contrasting color.
3. The operable part of manual fire-alarm box shall be between 42 inches (1060 mm) and 48 inches (1220 mm) above floor level. All devices shall be mounted at the same height unless otherwise indicated.

D. Smoke- or Heat-Detector Spacing:

1. Comply with the "Smoke-Sensing Fire Detectors" section in the "Initiating Devices" chapter in NFPA 72, for smoke-detector spacing.
2. Comply with the "Heat-Sensing Fire Detectors" section in the "Initiating Devices" chapter in NFPA 72, for heat-detector spacing.
3. Smooth ceiling spacing shall not exceed 30 feet (9 m).
4. Spacing of detectors for irregular areas, for irregular ceiling construction, and for high ceiling areas shall be determined according to Annex in NFPA 72.
5. HVAC: Locate detectors not closer than 36 inches ((910 mm)) from air-supply diffuser or return-air opening.
6. Lighting Fixtures: Locate detectors not closer than 12 inches (300 mm) from any part of a lighting fixture and not directly above pendant mounted or indirect lighting.

E. Install a cover on each smoke detector that is not placed in service during construction. Cover shall remain in place except during system testing. Remove cover prior to system turnover.

F. Duct Smoke Detectors: Comply with NFPA 72 and NFPA 90A. Install sampling tubes so they extend the full width of duct. Tubes more than 36 inches (9100 mm) long shall be supported at both ends.

1. Do not install smoke detector in duct smoke-detector housing during construction. Install detector only during system testing and prior to system turnover.

G. Remote Status and Alarm Indicators: Install in a visible location near each smoke detector, sprinkler water-flow switch, and valve-tamper switch that is not readily visible from normal viewing position.

H. Audible Alarm-Indicating Devices: Install not less than 6 inches (150 mm) below the ceiling. Install bells and horns on flush-mounted back boxes with the device-operating mechanism concealed behind a grille. Install all devices at the same height unless otherwise indicated.

I. Visible Alarm-Indicating Devices: Install adjacent to each alarm bell or alarm horn and at least 6 inches (150 mm) below the ceiling. Install all devices at the same height unless otherwise indicated.

J. Device Location-Indicating Lights: Locate in public space near the device they monitor.

3.3 PATHWAYS

A. Pathways above recessed ceilings and in nonaccessible locations may be routed exposed.

1. Exposed pathways located less than 96 inches (2440 mm) above the floor shall be installed in EMT.

B. Pathways shall be installed in EMT.

C. Exposed EMT shall be painted red enamel.

3.4 CONNECTIONS

A. Make addressable connections with a supervised interface device to the following devices and systems. Install the interface device less than 36 inches (910 mm) from the device controlled. Make an addressable confirmation connection when such feedback is available at the device or system being controlled.

1. Alarm-initiating connection to smoke-control system (smoke management) at firefighters' smoke-control system panel.
2. Alarm-initiating connection to stairwell and elevator-shaft pressurization systems.
3. Smoke dampers in air ducts of designated HVAC duct systems.
4. Electronically locked doors and access gates.
5. Supervisory connections at valve supervisory switches.
6. Supervisory connections at fire-extinguisher locations.
7. Supervisory connections at fire-pump power failure including a dead-phase or phase-reversal condition.
8. Supervisory connections at fire-pump engine control panel.

3.5 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

B. Install framed instructions in a location visible from fire-alarm control unit.

3.6 GROUNDING

A. Ground fire-alarm control unit and associated circuits; comply with IEEE 1100. Install a ground wire from main service ground to fire-alarm control unit.

B. Ground shielded cables at the control panel location only. Insulate shield at device location.

3.7 FIELD QUALITY CONTROL

A. Field tests shall be witnessed by authorities having jurisdiction.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

C. Perform tests and inspections.

D. Perform the following tests and inspections with the assistance of a factory-authorized service representative:

1. Visual Inspection: Conduct visual inspection prior to testing.

   a. Inspection shall be based on completed record Drawings and system documentation that is required by the "Completion Documents, Preparation" table in the "Documentation" section of the "Fundamentals" chapter in NFPA 72.
   b. Comply with the "Visual Inspection Frequencies" table in the "Inspection" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72; retain the "Initial/Reacceptance" column and list only the installed components.

2. System Testing: Comply with the "Test Methods" table in the "Testing" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72.
3. Test audible appliances for the public operating mode according to manufacturer's written instructions. Perform the test using a portable sound-level meter complying with Type 2 requirements in ANSI S1.4.
4. Test audible appliances for the private operating mode according to manufacturer's written instructions.
5. Test visible appliances for the public operating mode according to manufacturer's written instructions.
6. Factory-authorized service representative shall prepare the "Fire Alarm System Record of Completion" in the "Documentation" section of the "Fundamentals" chapter in NFPA 72 and the "Inspection and Testing Form" in the "Records" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72.

E. Reacceptance Testing: Perform reacceptance testing to verify the proper operation of added or replaced devices and appliances.

F. Fire-alarm system will be considered defective if it does not pass tests and inspections.

G. Prepare test and inspection reports.

H. Maintenance Test and Inspection: Perform tests and inspections listed for weekly, monthly, quarterly, and semiannual periods. Use forms developed for initial tests and inspections.

I. Annual Test and Inspection: One year after date of Substantial Completion, test fire-alarm system complying with visual and testing inspection requirements in NFPA 72. Use forms developed for initial tests and inspections.

3.8 MAINTENANCE SERVICE

A. Initial Maintenance Service: Beginning at Substantial Completion, maintenance service shall include 12 months' full maintenance by skilled employees of manufacturer's designated service organization. Include preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper operation. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.

1. Include visual inspections according to the "Visual Inspection Frequencies" table in the "Testing" paragraph of the "Inspection, Testing and Maintenance" chapter in NFPA 72.
2. Perform tests in the "Test Methods" table in the "Testing" paragraph of the "Inspection, Testing and Maintenance" chapter in NFPA 72.
3. Perform tests per the "Testing Frequencies" table in the "Testing" paragraph of the "Inspection, Testing and Maintenance" chapter in NFPA 72.

3.9 SOFTWARE SERVICE AGREEMENT

A. Comply with UL 864.

B. Technical Support: Beginning at Substantial Completion, service agreement shall include software support for two years.

C. Upgrade Service: At Substantial Completion, update software to latest version. Install and program software upgrades that become available within two years from date of Substantial Completion. Upgrading software shall include operating system and new or revised licenses for using software.

1. Upgrade Notice: At least 30 days to allow Owner to schedule access to system and to upgrade computer equipment if necessary.

3.10 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain fire-alarm system.

END OF SECTION 28 31 11

SECTION 31 11 00 - CLEARING AND GRUBBING

PART 1 - GENERAL

1.1 DESCRIPTION

A. This Section specifies the requirements for Site clearing which may consist of:

1. Protection of trees indicated to be preserved.

2. Protection of above-ground and below-ground existing improvements indicated to be preserved.

3. Clearing, grubbing, removal and disposal of trees, stumps, brush, roots, vegetation, logs and rubbish.

4. Removal and disposal of above-ground and below-ground materials and existing improvements, including building demolition if any, as indicated.

5. Stripping and stockpiling of topsoil.

6. Stripping and stockpiling natural leaf mulch.

1.2 SUBMITTALS

A. In accordance with Section 00 72 00 – Uniform General Conditions, Sub-Section UGC 8.3 for Texas State University System (TSUS) projects.

1.3 JOB CONDITIONS

A. Conduct demolition operations and removal of debris in accordance with governing regulations and Section 024117 - Demolition of these Specifications.

B. Ensure minimum interference with adjacent occupied or used facilities.

C. Exercise care to protect adjacent building, structures, and persons.

D. Above-ground and below-ground existing improvements, indicated to remain, shall be protected from damage prior to and during construction operations.

E Tree Protection

1. Trees to be preserved shall be protected by barricades to avoid any confusion and damage prior to site clearing operations.

2. Contractor shall install barricades 3 ft. beyond drip line of trees to be protected. Construction equipment or storage activities shall not be permitted within the fenced area.

F. Protection of Existing Utilities and Adjacent Work

1. Prior to earthwork operations, existing utilities, facilities and permanent objects to remain shall be located and adequately protected. When working near public and private utility company lines, Contractor shall contact the local utility coordinating committee or the utility company involved to locate their lines.

2. If unknown and uncharted utilities are encountered during excavation, promptly notify Owner and the governing utility company when determinable and wait for instructions.

3. If it is determined by Owner that such utility line has been abandoned, properly cap line at a depth approved by Owner or remove line as directed.

4. If such unknown utilities are encountered and work is continued without contacting the Owner for instructions, and the encountered utilities are damaged by continuation of the work, Contractor shall repair, at this own expense, such damage to the satisfaction of the Owner and the Utility Company. The Contractor shall be responsible for all costs to repair the damage.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 CLEARING

A. Trees to be removed, stumps, brush, roots and vegetation shall be removed to a depth of not less than 2 feet below original or finish ground level, whichever is lower.

B. Miscellaneous vegetation, logs and rubbish shall be removed in their entirety, within the limits of improvements.

D. Topsoil shall be stripped to underlying subsoil. Topsoil shall be defined as friable organic clay loam surface soil, reasonably free of clay lumps, stones, weeds, roots and other objectionable material. Topsoil shall be safely stockpiled on the Site. Stockpiles shall be constructed to freely drain surface water.

E. Depressions caused by clearing, grubbing and stripping operations shall be filled with approved backfill material, unless further excavation is required by the construction operations. Backfill shall be placed in accordance with Section 312300 – Excavation, Grading, and Fill of these Specifications.

3.2 REMOVAL OF IMPROVEMENTS

A. Above-ground and below-ground existing improvements shall be removed in their entirety, except for utilities which shall be removed only to the extent indicated. Where utilities are indicated to be removed in part, the ends of the remaining utilities shall be permanently plugged with Class 3000 concrete.

3.3 DISPOSAL OF MATERIALS

A. Materials not scheduled to be salvaged shall become the property of the Contractor and shall be removed from the Site and legally disposed of. Burning or burying cleared, grubbed and demolition waste materials on the Site shall not be permitted.

B. Remove items, without damaging, scheduled to be salvaged as directed by the engineer and placed in designated storage area.

END OF SECTION 31 11 00

SECTION 31 23 00 - GRADING EXCAVATION AND FILL

PART 1 - GENERAL

1.1 RELATED WORK SPECIFIED ELSEWHERE

A. PROTECTION OF TREES.

B. FIELD ENGINEERING FOR SITE LAYOUT.

C. TESTING LABORATORY SERVICES.

D. FILL MATERIAL FOR PAVEMENT SUB BASE.

E. CONCRETE REINFORCING.

F. CAST-IN-PLACE CONCRETE.

G. INFORMATIONAL REFERENCE TO SITE SURVEY AND TO SUBSURFACE CONDITIONS.

1.2 QUALITY ASSURANCE

A. REFERENCE STANDARDS:

1. ASTM D 698, TEST FOR MOISTURE-DENSITY RELATIONS OF SOILS (STANDARD PROCTOR).
2. ASTM D 2922, TEST FOR DENSITY OF SOIL IN PLACE BY NUCLEAR METHOD.
3. ASTM D 2487, CLASSIFICATION OF SOILS FOR ENGINEERING PURPOSES.

1.3 SUBMITTALS

A. SAMPLES:

1. SUBMIT 10 POUND SAMPLE QUANTITY OF FILL MATERIALS.
2. SUBMIT 20 POUND SAMPLE QUANTITY OF TOPSOIL MATERIAL.
3. PACK TIGHTLY IN CONTAINERS TO PREVENT CONTAMINATION.

1.4 GRADES

A. CAREFULLY COMPARE NEW GRADE REQUIREMENTS WITH EXISTING CONDITIONS.

B. PROVIDE NECESSARY EARTH, GRADING AND SHAPING WORK.

C. EXTRA PAYMENT WILL NOT BE AUTHORIZED FOR OVERAGE OR SHORTAGE OF MATERIAL.

PART 2 – PRODUCTS

2.1 MATERIALS

A. SUB BASE MATERIAL: UNWASHED PIT RUN OR CRUSHED GRAVEL, CRUSHED STONE, OR CRUSHED SLAG, NATURALLY OR ARTIFICIALLY GRADED WITH MAXIMUM AGGREGATE SIZE OF 1-1/2 INCHES, AS ACCEPTABLE TO TESTING LABORATORY.

B. BACKFILL AND FILL MATERIAL: SOIL MATERIALS FREE OF DEBRIS, WASTE, FROZEN MATTER, VEGETABLE AND OTHER DELETERIOUS MATTER, AS ACCEPTABLE TO TESTING LABORATORY.

C. SELECT FILL: IMPORTED LEAN CLAY WITH A NARROW PLASTICITY INDEX (PI) RANGE OF 10 TO 15.

D. LIME TREATED STRUCTURAL FILL: ON-SITE CLAY MIXTURE, FREE OF SILT, LOAM, FRIABLE OR SOLUBLE MATERIALS AND ORGANIC MATTER; TREATED IN 6 INCH LIFTS WITH 36 POUNDS PER SQUARE YARD OF HYDRATED LIME.

E. BACKFILL:

1. FREE FROM ROCKS LARGER THAN 3 INCHES IN SIZE, ALKALI, SALT, PETROLEUM PRODUCTS, DEBRIS, WASTE, ROOTS, VEGETABLE AND OTHER DELETERIOUS MATTER.

2. EXCESS NON-VEGETATED EXCAVATED SOILS AVAILABLE FROM SITE MAY BE USED IF CONFORMING TO SPECIFIED REQUIREMENTS.

F. LIME: MATERIAL CONFORMING TO SDHPT ITEM 264, "HYDRATED LIME AND LIME SLURRY".

G. SOIL FILTER FABRIC: MIRAFI "1405" IS SPECIFIED; DUPONT "TYPAR" IS ACCEPTABLE, OR APPROVED EQUAL.

PART 3 EXECUTION

3.1 OBSTRUCTIONS

A. REMOVE OBSTRUCTIONS WITHIN LINES OF IMPROVEMENTS.

B. REFER OBSTRUCTIONS OF QUESTIONABLE NATURE TO ENGINEER.

C. REMOVE ABANDONED FOUNDATIONS DOWN TO 12 INCHES BELOW FINISHED GRADE, OR THE FINISHED ELEVATION OF PAVEMENTS AND WALKS UNLESS INDICATED OTHERWISE ON THE DRAWINGS.

D. REMOVE FOUNDATIONS OF LIGHT STANDARDS COMPLETELY.

3.2 STRIPPING

A. STRIP ENTIRE AREA TO RECEIVE PAVEMENT AND SLABS ON GRADE TO A MINIMUM DEPTH OF SIX INCHES TO REMOVE SOIL CONTAINING VEGETATED MATERIAL.

B. REMOVE VEGETATED MATERIAL FROM SITE AS WASTE.

C. REMOVE TOPSOIL; SPREAD ON AREAS ALREADY GRADED AND PREPARED FOR TOPSOIL, OR DEPOSIT IN STORAGE PILES CONVENIENT TO AREAS SUBSEQUENTLY TO RECEIVE TOPSOIL.

D. SCARIFY EXISTING ASPHALT SURFACING AND FLEXIBLE BASE COURSE MATERIAL AND REMOVE FROM SITE.

E. REMOVE EXISTING SITE IMPROVEMENTS IN AREAS SCHEDULED TO RECEIVE LAWNS, BUILDINGS, AND PAVEMENTS.

F. STRIPPED MATERIAL BECOMES PROPERTY OF CONTRACTOR; REMOVE FROM PROJECT SITE IMMEDIATELY AND DISPOSE OF PROPERLY.

G. MAINTAIN SITE SURFACE DRAINAGE DURING CONSTRUCTION.

3.3 EXCAVATION AND COMPACTION BELOW GRADE BEAMS AND SLABS-ON-GRADE

A. EXCAVATE SUB GRADE FOR THE BUILDING FOOTPRINT TO ALLOW A MINIMUM OF 4 FEET OF THICKNESS BELOW THE BOTTOM OF THE SLABS-ON-GRADE .IN ACCORDANCE WITH LINES AND GRADES REQUIRED FOR CONSTRUCTION OF THE WORK, INCLUDING SPACE FOR PLACING AND REMOVAL OF FORMS, BRACING AND SHORING, FOR INSPECTION AND A MINIMUM OF 5 FEET BEYOND THE BUILDING LINE.

B. MAINTAIN EXCAVATIONS FREE OF LOOSE EARTH, DEBRIS, AND KEEP DRY UNTIL PLACEMENT OF CONCRETE.

C. PROOF ROLL THE SOIL AT THE BASE OF THE EXCAVATION USING A RUBBER-TIRED VEHICLE WEIGHING ABOUT 20 TONS, SUCH AS A LOADED DUMP OR WATER TRUCK.

D. REMOVE AND REPLACE ANY SOFT OR WEAK SOILS IDENTIFIED. DISKING, DRYING AND RECOMPACTION DURING DRY WEATHER OR TREATMENT WITH A CHEMICAL ADDITIVE MAY BE USED AS NEEDED AS REMEDIAL OPTIONS.

E. PLACE A MINIMUM 3 FEET THICKNESS STRUCTURAL FILL AND SELECT AS RECOMMENDED BY THE SOILS REPORT, FILL AS INDICATED, IN CONSECUTIVE 8 INCH MAXIMUM LOOSE LIFTS. COMPACT ANY LIME TREATED CLAY AND SELECT FILL TO AT LEAST 95 PERCENT OF THE STANDARD PROCTOR MAXIMUM DENSITY ACCORDING TO ASTM D 698.

F. IF HIGH MOISTURE CONTENT IS DETERMINED BY ASTM D698, COMPARE THE IN-PLACE DENSITY OF LIME-TREATED CLAYS WITH 90 PERCENT OF THE MAXIMUM DENSITY DETERMINED BY MODIFIED EFFORT ACCORDING TO ASTM D 1557, IF REQUIRED. THE ACTUAL RANGE OF MOISTURE WITHIN WHICH SPECIFIED COMPACTION CAN BE ACHIEVED MAY BE ADJUSTED ONCE THE MOISTURE-DENSITY RELATIONSHIP FOR THE STRUCTURAL FILL HAS BEEN DEVELOPED.

G. PROTECT OPEN EXCAVATIONS WITH COVERINGS AS NECESSARY TO MAINTAIN EXISTING SOIL MOISTURE CONTENT.

3.4 EXCAVATION FOR UTILITY TRENCHES

A. EXCAVATE USING LADDER-TYPE TRENCHING MACHINE OR BACKHOE UNLESS INDICATED OTHERWISE.

B. CUT TRENCH SIDES VERTICAL FROM TRENCH BOTTOM TO ONE FOOT ABOVE TOP OF PIPE; SLOPE BACK ON STABLE SLOPE ABOVE THAT POINT.

C. EXTEND TRENCH WIDTH MINIMUM 6 INCHES AND MAXIMUM 18 INCHES EACH SIDE OF PIPE.

D. EXCAVATE TRENCH TO A MINIMUM DEPTH OF 4 INCHES BELOW BOTTOM ELEVATION OF PROPOSED PIPELINES.

E. LEAVE NO MORE THAN 500 FEET OF TRENCH OPEN AT ONE TIME.

F. WHERE AUGURED HOLE IS INDICATED, PROVIDE OPENING NO LARGER THAN ONE INCH GREATER THAN OUTSIDE DIAMETER OF PIPE BELL.

3.5 DEWATERING

A. KEEP EXCAVATIONS DRY; MAINTAIN DEWATERED CONDITION FOR DEPTH OF ONE FOOT BELOW EXCAVATION BOTTOM.

B. OPERATE SUITABLE PUMPS NECESSARY TO KEEP EXCAVATIONS CONTINUOUSLY FREE OF WATER.

C. DISCHARGE DRAINAGE WATERLINES INTO APPROVED SEWERS ONLY WITH APPROPRIATE APPROVALS; USE OF SANITARY SEWER IS PROHIBITED.

D. DIRECT SURFACE DRAINAGE AWAY FROM EXCAVATED AREAS.

E. CONTROL GRADING ADJACENT TO EXCAVATIONS TO PREVENT WATER RUNNING INTO EXCAVATED AREAS.

3.6 PERIMETER BACKFILL

A. BACKFILL EXTERIOR SIDE OF PERIMETER OF STRUCTURE WITH LIME-TREATED ON-SITE CLAY MATERIALS, CARRYING SUCH FILL UP TO INDICATED SUB GRADES.

B. BACKFILL SYSTEMATICALLY AND AS EARLY AS POSSIBLE TO ALLOW MAXIMUM TIME FOR NATURAL SETTLEMENT AND COMPACTION.

C. COMMENCE BACKFILLING AFTER UNDERGROUND WORK HAS BEEN INSPECTED, TESTED, FORMS REMOVED, AND EXCAVATION CLEANED OF TRASH AND DEBRIS.

D. PLACE AND COMPACT BACKFILL TO MINIMIZE SETTLEMENT AND AVOID DAMAGE TO WORK IN PLACE.

E. PLACE BACKFILL SIMULTANEOUSLY ON BOTH SIDES OF FREESTANDING STRUCTURES; PREVENT WEDGING ACTION AGAINST STRUCTURE.

F. PLACE MATERIALS IN SUCCESSIVE HORIZONTAL LAYERS OF NOT MORE THAN 8 INCHES (4 INCHES FOR HANDHELD TAMPING EQUIPMENT) AND UNIFORMLY COMPACTED TO 92% OF MAXIMUM DENSITY AS CONFIRMED BY TESTING LABORATORY.

3.7 UTILITY TRENCH BACKFILL

A. PIPE BEDDING AND BACKFILL REQUIREMENTS FOR SANITARY SEWERS SHALL BE AS SPECIFIED IN SECTION 02730, SANITARY SEWAGE SYSTEMS.

B. PIPE BEDDING AND BACKFILL REQUIREMENTS FOR STORM SEWERS SHALL BE AS SPECIFIED IN SECTION 02720, STORM SEWAGE SYSTEMS.

C. PIPE BEDDING AND BACKFILL FOR WATER DISTRIBUTION SYSTEM PIPING SHALL BE IN ACCORDANCE WITH CITY OF BEAUMONT "SPECIFICATIONS FOR WATER MAIN CONSTRUCTION AND MATERIALS" AND "SPECIFICATIONS FOR WATER TAPS AND SERVICE LINES", 3/4-INCH THROUGH 2-INCH, WITH LATEST ADDENDA AND AMENDMENTS THERETO.

D. BACKFILL TRENCH AS SOON AS POSSIBLE AFTER PIPE HAS BEEN LAID, JOINTED, AND INSPECTED; COMPLETE BACKFILLING AT END OF EACH DAY.

B. WITHIN PIPE ZONE: PLACE BACKFILL MATERIAL AND HAND TAMP IN 6 INCH LAYERS TO ONE FOOT ABOVE TOP OF PIPE.

E. USE OF BULLDOZER OR SIMILAR TRACKED EQUIPMENT IS UNACCEPTABLE FOR COMPACTION.

3.8 PREPARATION OF SUBGRADE FOR PAVING, WALKS AND EXTERIOR SLABS

A. CUT AND FILL AREAS AS REQUIRED.

B. PROOF ROLL SUB GRADE WITH HEAVY ROLLER. CUT OUT ANY SOFT AREA THAT CANNOT BE COMPACTED BY SURFACE ROLLING AND REPLACE WITH COMPACTED SELECT FILL.

C. PROVIDE SELECT FILL AT AREAS WHERE REQUIRED TO ELEVATE SUB GRADE. LIME STABILIZATION: STABILIZE TO DEPTH OF 8 INCHES WITH LIME SLURRY IN ACCORDANCE WITH TXDOT ITEM 260. **SUBGRADE BENEATH SIDEWALKS SHALL NOT BE LIME STABILIZED.**

D. COMPACT TO NOT LESS THAN 85 TO 92% OF MAXIMUM DENSITY IN ACCORDANCE WITH ASTM D698 AS CONFIRMED BY TESTING LABORATORY; WITH MOISTURE CONTENT FOR COMPACTED MATERIAL WITHIN +/- 2% OF OPTIMUM MOISTURE.

E. MAINTAIN SITE SURFACE DRAINAGE DURING CONSTRUCTION.

3.9 ROUGH GRADING

A. SHAPE SUB GRADE TO ALLOW FOR MAXIMUM AMOUNT OF NATURAL SETTLEMENT AND COMPACTION.

B. REMOVE DEBRIS, ROOTS, BRANCHES, STONES, IN EXCESS OF 2 INCHES IN SIZE.

C. REMOVE SUBSOIL WHICH HAS BEEN CONTAMINATED WITH PETROLEUM PRODUCTS.

D. EXCAVATE AREAS, TO SUB GRADE ELEVATION, WHICH ARE TO RECEIVE PAVING AND SIDEWALKS.

E. BRING SUB GRADE TO REQUIRED LEVELS, PROFILES AND CONTOURS, MAKING GRADUAL CHANGES IN GRADE; BLEND SLOPES INTO LEVEL AREAS.

F. SLOPE GRADE AWAY FROM BUILDING MINIMUM 2 INCHES IN 10 FEET UNLESS INDICATED OTHERWISE.

G. CULTIVATE SUB GRADE TO A DEPTH OF 3 INCHES WHERE TOPSOIL IS TO BE PLACED; REPEAT CULTIVATION IN AREAS WHERE EQUIPMENT USED FOR HAULING AND SPREADING TOPSOIL HAS COMPACTED SUB GRADE.

H. MAINTAIN SITE SURFACE DRAINAGE DURING CONSTRUCTION.

3.10 SURPLUS MATERIALS

A. REMOVE SURPLUS SUBSOIL FROM SITE.

B. LEAVE STOCKPILE AREAS AND ENTIRE JOB SITE CLEAN AND RAKED, READY TO RECEIVE LANDSCAPING.

3.11 CLEAN-UP

A. REMOVE TEMPORARY STRUCTURES, RUBBISH, AND WASTE MATERIALS FROM WORK SITE DAILY.

END OF SECTION 31 23 00

SECTION 320190.13

LANDSCAPE MAINTENANCE FOR 90 DAYS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes requirements for 90 day landscape maintenance for the following:

1. Watering trees and grass.
2. Monitoring adjustment and minor repair of the landscape irrigation system.
3. Mowing, edging and trimming of lawn areas.
4. Monitoring, fertilizing, weeding, and cultivating of lawn areas.
5. Pruning and trimming of plant material.
6. Weed, cultivating and cleaning of planting beds.
7. Application of fertilizers, insecticides, and herbicides.
8. General site clean up; removal of trash and products of maintenance.
9. Replacement of trees, shrubs, groundcovers, sod and hydromulch.
10. Sediment removal from bayou high water.
11. Extra services as needed.

B. Related Sections

1. Turfs and Grasses - Section 329200
2. Trees, Shrubs, and Ground Covers - Section 329313
3. Planting Irrigation Systems – Section 328400

1.2 DEFINITIONS

A. Backfill: The earth used to replace or the act of replacing earth in an excavation.

B. Finish Grade: Elevation of finished surface of planting soil.

C. Manufactured Topsoil: Soil produced off-site by homogeneously blending mineral soils or sand with stabilized organic soil amendments to produce topsoil or planting soil.

D. Planting Soil: Native or imported topsoil, manufactured topsoil, or surface soil modified to become topsoil; mixed with soil amendments.

E. Subgrade: Surface or elevation of subsoil remaining after completing excavation, or top surface of a fill or backfill, before placing planting soil.

Subsoil: All soil beneath the topsoil layer of the soil profile, and typified by the lack of organic matter and soil organisms.

1.3 EXTRA SERVICES

A. All services not covered under this contract shall be considered "extra services" and will be charged for separately according to the nature of the item of work. The consent and authorization of the Owner or their authorized representative must be obtained prior to the performance or installation of such "extra services" items and prior to purchase of any chargeable materials.

B. Plant replacements as a result of flood damage.

1.4 MAINTENANCE REQUIREMENTS

A. Begin maintenance after each plant and lawn portion is installed.

B. Maintenance period shall begin upon inspection and approval at Substantial Completion by phase and shall be for ninety (90) days.

C. Sprinkler Irrigation System: Maintenance of the sprinkler irrigation system shall consist of monitoring and adjustment of the duration and frequency of the watering schedule, adjustment of heads for coverage and elevation, repair of leaks in both mains and lateral lines and all other work required to establish a complete working sprinkler irrigation system.

D. Trees, Shrubs, Groundcovers and Vines: Maintenance of new planting shall consist of watering, cultivating, weeding, mulching, re-staking, tightening and repairing of guys, resetting plants to proper grades or upright position, restoration of the planting saucer, and furnishing and applying such sprays and invigorants as are necessary to keep the plantings free of insects and disease and in thriving condition.

E. Lawns: Maintenance of new lawns shall consist of mowing, edging, raking, watering, weeding, fertilizing, and repair of all erosion, reseeding and resodding as necessary, to establish a uniform stand of the specified grasses.

1.5 PROTECTION

A. Protect planting areas and lawns at all times against damage of all kinds for duration of maintenance period. Maintenance includes temporary protection fences, barriers and signs as required for protection. If any plants become damaged or injured, because sufficient protection was not provided, treat or replace as directed by Owner at no additional cost to Owner.

1.6 NEGLECT AND VANDALISM

A. Turf, shrubs, trees or plants that are damaged or killed due to contractors operations, negligence or chemicals shall be replaced at no expense to the Owner. If plant damage or death is caused by conditions beyond the contractor's control, replacement shall be at the Owner's expense.

B. Sprinklers or structures that are damaged due to the contractor's operations must be replaced by the contractor promptly. Likewise, damage to the irrigation system by others shall be corrected immediately by the contractor, at the Owner's expense.

C. All man made water damage, resulting from Contractor's neglect shall be corrected at Contractor's expense.

D. All damage to or thefts of landscaping and irrigation installations not caused or allowed by the contractor shall be corrected by the contractor at the Owner's expense upon receipt of written authorization to proceed.

1.7 EMERGENCIES

A. Answer emergency or complaint calls regarding conditions in landscaped areas regarding fallen trees or branches or shrubs or trees that obstruct the trail or other pavement within 1 hour and correct the problem or place warning signs and advise the Owner of the need for major work to be performed within 4 hours of the initial contact.

B. Answer emergency calls regarding the landscape irrigation system failure or need of repair.

1.8 FINAL ACCEPTANCE

A. Work under this Section will be accepted by Owner’s representative upon satisfactory completion of all work, including maintenance, but exclusive of the required guaranteed sprinkler irrigation obligations, replacement of plant materials and lawns under the Warranty Period. Upon Final Acceptance, the Owner will assume responsibility for maintenance of the work.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Fertilizers, soil amendments, equipment, or other materials required for installed items shall match those already in use.

B. Samples of all materials not specified under other Sections of these Specifications shall be submitted for review by Owner’s representative prior to use.

PART 3 - EXECUTION

3.1 REQUIRED EQUIPMENT

A. Employ the necessary maintenance equipment.

3.2 WATERING

A. It shall be the responsibility of the Contractor to assure that the correct watering of plant materials is being accomplished through the following irrigation services:

1. Regular deep watering to all new trees until there are definite signs that the trees have established themselves and new growth is apparent. Deep watering shall be accomplished with hoses and water truck equipment.
2. Frequent watering to the lawn areas to insure against drying. This may be accomplished as above, by hand watering or portable sprinklers.

3.3 LANDSCAPE IRRIGATION SYSTEM

A. Monitor and program the automatic controlling devices to provide optimum moisture levels in all planted areas.

1. Irrigation cycles shall be set to take place prior to sunrise (usually 4:00 - 5:00 am) unless otherwise instructed by the Owner, except during visits of grounds maintenance personnel; during such visits the irrigation system may be operated as desired by those personnel.
2. If there is more than one irrigation controller, do not program to water during the same time period as over-draft of water meters will result. Set controllers so that one finishes watering cycle before next starts watering cycle. During periods of high rainfall, set controllers to "dry mode" until irrigation is needed. Do not switch controller to "off", as this will stop time clock.
3. Complete sprinkler system servicing shall be performed as required to maintain sprinklers in correct operating condition, including all required labor. Operation of sprinklers shall be monitored on a bi-monthly basis to assure proper cover and operation.
4. Adjust sprinklers to avoid damage to windows and buildings. Make repairs and alterations to the sprinkling system and water lines. All sprinklers repairs such as cleaning of heads or breaks caused by the Contractor shall be the Contractor's responsibility.
5. Perform minor additions, subtractions and/or adjustments to irrigation equipment (i.e., addition of spray head or riser extension) as may be required in order to conform to the irrigation requirements herein specified. Such additions, subtractions and/or realignments to irrigation system equipment shall not materially reduce the extent or value of the irrigation system equipment, and shall be accomplished after securing approval of the Owner.
6. Supplemental irrigation beyond that which can be provided by the irrigation system shall be provided by the grounds maintenance firm as required in order to assure optimum moisture levels.
7. Sediment removal from project site as a result of bayou tide rising and receding by use of project stand pipes.

3.4 MAINTENANCE OF TURF AREAS

A. Mowing lawn/grass areas shall be accomplished with sharp, properly adjusted mowers of the correct size for the various areas.

B. Mowing frequency shall be as per the Landscape Maintenance Program. Blade heights shall be set according to the following schedule:
   2 Inches Initial Mowing
   2-1/2 Inches April - November

C. In the event of a prolonged rainy period and a surge of leaf growth is anticipated, the mower height may be re-adjusted to prevent "scalping" or skinning of lawn on preceding cuts.

D. Lawn shall be edged evenly at all walks, headers and other structures as per Landscape Maintenance Program.

E. Until the establishment of the turf, the Contractor will be responsible for replacing soils that have eroded onto the paved areas. Residual soils on paving will be removed and if not mingled with objectionable materials, may be re-used in eroded areas.

F. Immediately upon observing any lawn grass spreading into shrub or groundcover areas, the Contractor shall initiate a program of mechanical removal and maintain this program throughout the maintenance period.

G. Any lawn grass appearing in paved areas shall receive an application of soil sterilant according to manufacturer's direction. The sterilant shall be approved and will not be detrimental structurally to paved areas.

H. Special effort shall be given to the control of fire ants infesting the site. After control is accomplished, the ant mounds shall be lowered and tamped to the existing grade.

I. Removal of debris from the site unrelated to horticultural maintenance (paper, bottles, cans, "Pirate" signs, etc.) shall be the responsibility of the maintenance Contractor and limited to areas designated.

3.5 MAINTENANCE OF TREES, SHRUBS, AND GROUNDCOVERS

A. Contractor shall adjust and tighten as required all tree staking and guying. Removal as directed by Owner's Representative.

B. Contractor shall deep water all new trees until there are definite signs the trees have established themselves and are pushing out new growth.

C. Watering basins shall be removed by Contractor after the trees have established themselves or as directed by Owner's representative. Basins are normally removed one year from time of planting.

D. Contractor shall be continuously alert for signs of insect presence or damage or the presence or damage from plant fungi. Upon locating such evidence, the Contractor shall report it to the Owner's representative and take action as directed.

3.6 MAINTENANCE FREQUENCY SCHEDULE

A. Mowing, Edging, Trimming, Litter Cleanup, and Watering Monitoring: Four visits per month for 12 months.

B. Top-dress Fertilizer: Thirty days after seeding and/or sodding.

C. Mulching, Weeding, Weed Control, and Guying Adjustment: As required each visit.

D. Reseeding: As required upon notice.

E. Tree and Plant Replacement: As required each visit.

F. Trash and Debris Removal: Collect all trash and debris at each visit and dispose of off-site.

END OF SECTION 320190.13

SECTION 320190.16

LANDSCAPE MAINTENANCE FOR TWELVE MONTHS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes requirements for twelve month landscape maintenance for the following:

1. Watering trees and grass.
2. Monitoring adjustment and minor repair of the landscape irrigation system.
3. Mowing, edging and trimming of lawn areas.
4. Monitoring, fertilizing, weeding, and cultivating of lawn areas.
5. Pruning and trimming of plant material.
6. Weed, cultivating and cleaning of planting beds.
7. Application of fertilizers, insecticides, and herbicides.
8. General site clean up; removal of trash and products of maintenance.
9. Replacement of trees, shrubs, groundcovers, sod and hydromulch.
10. Sediment removal from bayou high water.
11. Extra services as needed.

B. Related Sections
1. Planting Irrigation Systems – Section 328400
2. Turfs and Grasses - Section 329200
3. Trees, Shrubs, and Ground Covers - Section 329313

1.2 DEFINITIONS

A. Backfill: The earth used to replace or the act of replacing earth in an excavation.

B. Finish Grade: Elevation of finished surface of planting soil.

C. Manufactured Topsoil: Soil produced off-site by homogeneously blending mineral soils or sand with stabilized organic soil amendments to produce topsoil or planting soil.

D. Planting Soil: Native or imported topsoil, manufactured topsoil, or surface soil modified to become topsoil; mixed with soil amendments.

E. Subgrade: Surface or elevation of subsoil remaining after completing excavation, or top surface of a fill or backfill, before placing planting soil.

F. Subsoil: All soil beneath the topsoil layer of the soil profile, and typified by the lack of organic matter and soil organisms.

1.3 EXTRA SERVICES

A. All services not covered under this contract shall be considered "extra services" and will be charged for separately according to the nature of the item of work. The consent and authorization of the Owner or their authorized representative must be obtained prior to the performance or installation of such "extra services" items and prior to purchase of any chargeable materials.

B. Plant replacements as a result of flood damage.

1.4 MAINTENANCE REQUIREMENTS

A. Begin maintenance after each plant and lawn portion is installed.

B. Maintenance period shall begin upon inspection and approval at Substantial Completion by phase and shall be for twelve (12) months.

C. Sprinkler Irrigation System: Maintenance of the sprinkler irrigation system shall consist of monitoring and adjustment of the duration and frequency of the watering schedule, adjustment of heads for coverage and elevation, repair of leaks in both mains and lateral lines and all other work required to establish a complete working sprinkler irrigation system.

D. Trees, Shrubs, Groundcovers and Vines: Maintenance of new planting shall consist of watering, cultivating, weeding, mulching, re-staking, tightening and repairing of guys, resetting plants to proper grades or upright position, restoration of the planting saucer, and furnishing and applying such sprays and invigorants as are necessary to keep the plantings free of insects and disease and in thriving condition.

E. Lawns: Maintenance of new lawns shall consist of mowing, edging, raking, watering, weeding, fertilizing, and repair of all erosion reseeding, resodding, necessary to establish a uniform stand of the specified grasses.

1.5 PROTECTION

A. Protect planting areas and lawns at all times against damage of all kinds for duration of maintenance period. Maintenance includes temporary protection fences, barriers and signs as required for protection. If any plants become damaged or injured, because sufficient protection was not provided, treat or replace as directed by Owner at no additional cost to Owner.

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A. Turf, shrubs, trees or plants that are damaged or killed due to contractors operations, negligence or chemicals shall be replaced at no expense to the Owner. If plant damage or death is caused by conditions beyond the contractor's control, replacement shall be at the Owner's expense.

B. Sprinklers or structures that are damaged due to the contractor's operations must be replaced by the contractor promptly. Likewise, damage to the irrigation system by others shall be corrected immediately by the contractor, at the Owner's expense.

C. All man made water damage, resulting from Contractor's neglect shall be corrected at Contractor's expense.

D. All damage to or thefts of landscaping and irrigation installations not caused or allowed by the contractor shall be corrected by the contractor at the Owner's expense upon receipt of written authorization to proceed.

1.7 EMERGENCIES

A. Answer emergency or complaint calls regarding conditions in landscaped areas regarding fallen trees or branches or shrubs or trees that obstruct the trail or other pavement within 1 hour and correct the problem or place warning signs and advise the Owner of the need for major work to be performed within 4 hours of the initial contact.

B. Answer emergency calls regarding the landscape irrigation system failure or need of repair.

1.8 FINAL ACCEPTANCE

A. Work under this Section will be accepted by Owner’s representative upon satisfactory completion of all work, including maintenance, but exclusive of the required guaranteed sprinkler irrigation obligations, replacement of plant materials and lawns under the Warranty Period. Upon Final Acceptance, the Owner will assume responsibility for maintenance of the work.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Fertilizers, soil amendments, equipment, or other materials required for installed items shall match those already in use.

B. Samples of all materials not specified under other Sections of these Specifications shall be submitted for review by Owner’s representative prior to use.

PART 3 - EXECUTION

3.1 REQUIRED EQUIPMENT

A. Employ the necessary maintenance equipment.

3.2 WATERING

A. It shall be the responsibility of the Contractor to assure that the correct watering of plant materials is being accomplished through the following irrigation services:

1. Regular deep watering to all new trees until there are definite signs that the trees have established themselves and new growth is apparent. Deep watering shall be accomplished with hoses and water truck equipment.
2. Frequent watering to the lawn areas to insure against drying. This may be accomplished as above, by hand watering or portable sprinklers.

3.3 LANDSCAPE IRRIGATION SYSTEM

A. Monitor and program the automatic controlling devices to provide optimum moisture levels in all planted areas.

1. Irrigation cycles shall be set to take place prior to sunrise (usually 4:00 - 5:00 am) unless otherwise instructed by the Owner, except during visits of grounds maintenance personnel; during such visits the irrigation system may be operated as desired by those personnel.
2. If there is more than one irrigation controller, do not program to water during the same time period as over-draft of water meters will result. Set controllers so that one finishes watering cycle before next starts watering cycle. During periods of high rainfall, set controllers to "dry mode" until irrigation is needed. Do not switch controller to "off", as this will stop time clock.
3. Complete sprinkler system servicing shall be performed as required to maintain sprinklers in correct operating condition, including all required labor. Operation of sprinklers shall be monitored on a bi-monthly basis to assure proper cover and operation.
4. Adjust sprinklers to avoid damage to windows and buildings. Make repairs and alterations to the sprinkling system and water lines. All sprinklers repairs such as cleaning of heads or breaks caused by the Contractor shall be the Contractor's responsibility.
5. Perform minor additions, subtractions and/or adjustments to irrigation equipment (i.e., addition of spray head or riser extension) as may be required in order to conform to the irrigation requirements herein specified. Such additions, subtractions and/or realignments to irrigation system equipment shall not materially reduce the extent or value of the irrigation system equipment, and shall be accomplished after securing approval of the Owner.
6. Supplemental irrigation beyond that which can be provided by the irrigation system shall be provided by the grounds maintenance firm as required in order to assure optimum moisture levels.
7. Sediment removal from project site as a result of bayou tide rising and receding by use of project stand pipes.

3.4 MAINTENANCE OF TURF AREAS

A. Mowing lawn/grass areas shall be accomplished with sharp, properly adjusted mowers of the correct size for the various areas.

B. Mowing frequency shall be as per the Landscape Maintenance Program. Blade heights shall be set according to the following schedule:

2 Inches	Initial Mowing
2-1/2 Inches	April - November

C. In the event of a prolonged rainy period and a surge of leaf growth is anticipated, the mower height may be re-adjusted to prevent "scalping" or skinning of lawn on preceding cuts.

D. Lawn shall be edged evenly at all walks, headers and other structures as per Landscape Maintenance Program.

E. Until the establishment of the turf, the Contractor will be responsible for replacing soils that have eroded onto the paved areas. Residual soils on paving will be removed and if not mingled with objectionable materials, may be re-used in eroded areas.

F. Immediately upon observing any lawn grass spreading into shrub or groundcover areas, the Contractor shall initiate a program of mechanical removal and maintain this program throughout the maintenance period.

G. Any lawn grass appearing in paved areas shall receive an application of soil sterilant according to manufacturer's direction. The sterilant shall be approved and will not be detrimental structurally to paved areas.

H. Special effort shall be given to the control of fire ants infesting the site. After control is accomplished, the ant mounds shall be lowered and tamped to the existing grade.

I. Removal of debris from the site unrelated to horticultural maintenance (paper, bottles, cans, "Pirate" signs, etc.) shall be the responsibility of the maintenance Contractor and limited to areas designated.

3.5 MAINTENANCE OF TREES, SHRUBS, AND GROUNDCOVERS

A. Contractor shall adjust and tighten as required all tree staking and guying. Removal as directed by Owner's Representative.

B. Contractor shall deep water all new trees until there are definite signs the trees have established themselves and are pushing out new growth.

C. Watering basins shall be removed by Contractor after the trees have established themselves or as directed by Owner's representative. Basins are normally removed one year from time of planting.

D. Contractor shall be continuously alert for signs of insect presence or damage or the presence or damage from plant fungi. Upon locating such evidence, the Contractor shall report it to the Owner's representative and take action as directed.

3.6 MAINTENANCE FREQUENCY SCHEDULE

A. Mowing, Edging, Trimming, Litter Cleanup, and Watering Monitoring: Four visits per month for 12 months.

B. Top-dress Fertilizer: Thirty days after seeding and/or sodding.

C. Mulching, Weeding, Weed Control, and Guying Adjustment: As required each visit.

D. Reseeding: As required upon notice.

E. Tree and Plant Replacement: As required each visit.

F. Trash and Debris Removal: Collect all trash and debris at each visit and dispose of off-site.

END OF SECTION 320190.16

SECTION 32 12 16 - ASPHALTIC CONCRETE PAVEMENT

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Surface courses of compacted mixture of coarse and fine aggregates and asphaltic material.

1.2 MEASUREMENT AND PAYMENT

A. Stipulated Price (Lump Sum). If the Contract is a Stipulated Price Contract, payment for work in this Section is included in the total Stipulated Price.

1.3 REFERENCES

A. ASTM C 33 - Standard Specification for Concrete Aggregates.

B. ASTM C 131 - Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.

C. ASTM C 136 - Standard Method for Sieve Analysis of Fine and Coarse Aggregates.

D. TxDOT Tex-126-E - Molding, Testing, and Evaluation of Bituminous Black Base Material.

E. TxDOT Tex-106-E - Method of Calculating the Plasticity Index of Soils.

F. TxDOT Tex-203-F - Sand Equivalent Test.

G. TxDOT Tex-204-F - Design of Bituminous Mixtures.

H. TxDOT Tex-207-F - Determination of Density of Compacted Bituminous Mixtures.

I. TxDOT Tex-208-F - Test for Stabilometer Value of Bituminous Mixtures.

J. TxDOT Tex-217-F - Determination of Deleterious Material and Decantation Test for Coarse Aggregates.

K. TxDOT Tex-227-F - Theoretical Maximum Specific Gravity of Bituminous Mixtures.

1.4 SUBMITTALS

A. Submittals shall conform to requirements of Section 01 33 00- Submittal Procedures.

B. Submit certificates that asphaltic materials and aggregates meet requirements of Article 2.1, Materials, of this Section.

C. Submit proposed design mix and test data for each type and strength of surface course in Work.

D. Submit manufacturer's description and characteristics of mixing plant for approval.

E. Submit manufacturer's description and characteristics of spreading and finishing machine for approval.

PART 2 P R O D U C T S

2.1 MATERIALS

A. Coarse Aggregate: Gravel or crushed stone, or combination thereof, that is retained on No. 10 sieve, uniform in quality throughout and free from dirt, organic or other injurious matter occurring either free or as coating on aggregate. Aggregate shall conform to ASTM C 33 except for gradation. Furnish rock or gravel with Los Angeles abrasion loss not to exceed 40 percent by weight when tested in accordance with ASTM C 131.

B. Fine Aggregate: Sand or stone screenings or combination of both passing No. 10 sieve. Aggregate shall conform to ASTM C 33 except for gradation. Use sand composed of sound, durable stone particles free from loams or other injurious foreign matter. Furnish screenings of same or similar material as specified for coarse aggregate. Plasticity index of that part of fine aggregate passing No. 40 sieve shall be not more than 6 when tested by Tex-106-E. Sand equivalent shall have a minimum value of 45 when tested by Tex-203-F.

C. Composite Aggregate: Conform to following limits when graded in accordance with ASTM C 136.

GRADATION OF COMPOSITE AGGREGATE	
Sieve Size	Percent Passing
1/2"	100
3/8"	85 to 100
#4	50 to 70
#10	32 to 42
#40	11 to 26
#80	4 to 14
#200	1 to 6*
* 2 to 8 when Test Method Tex-200-F, Part II (Washed Sieve Analysis) is used.	

D. Asphaltic Material: Moisture-free homogeneous material which will not foam when heated to 347 degrees F, meeting following requirements:

VISCOSITY GRADE				
TEST	AC-10		AC-20	
	Min.	Max.	Min.	Max.
Viscosity, 140E F stokes	1000	± 200	2000	± 400
Viscosity, 275E F stokes	1.9	-	2.5	-
Penetration, 77E F, 100 g, 5 sec.	85	-	55	-
Flash Point, C.O.C., F.	450	-	450	-
Solubility in trichloroethylene, percent	99.0	-	99.0	-
Tests on residues from thin film oven tests:				
Viscosity, 140E F stokes	-	3000	-	6000
Ductility, 77E F, 5 cms per min., cms	70	-	50	-
Spot tests	Negative for all grades			

1. Material shall not be cracked.

2. Engineer will designate grade of asphalt to use after design tests have been made. Use only one grade of asphalt after grade is determined by test design for project.

2.2EQUIPMENT

A. Mixing Plant: Weight-batching or drum mix plant with capacity for producing continuously mixtures meeting specifications. Plant shall have satisfactory conveyors, power units, aggregate handling equipment, hot aggregate screens and bins, and dust collectors. Provide equipment to supply materials adequately in accordance with rated capacity of plant and produce finished material within specified tolerances. Following equipment is essential:

1. Cold aggregate bins and proportioning device.

2. Dryer.

3. Screens.

4. Aggregate weight box and batching scales.

5. Mixer.

6. Asphalt storage and heating devices.

7. Asphalt measuring devices.

8. Truck scales.

B. Bins: Separate aggregate into minimum of four bins to produce consistently uniform grading and asphalt content in completed mix.

2.3 MIXES

A. Employ a certified testing laboratory to prepare design mixes. Test in accordance with Tex-126-E or Tex-204-F and Tex-208-F.

B. Density and Stability Requirements:

Percent Density Min.	Max.	Percent Optimum	HVEEM Stability Percent Not Less Than
94.5	97.5	96	35

C. Proportions for Asphaltic Material: Provide 4 to 8 percent of mixture by weight. Aggregate by weight shall not contain more than 1.0 percent by weight of fine dust, clay-like particles, or silt when tested in accordance with Tex-217-F, Part II.

PART 3 E X E C U T I O N

3.1 EXAMINATION

A. Verify compacted base course is ready to support imposed loads.

B. Verify lines and grades are correct.

3.2 PREPARATION

A. Prime Coat: If indicated on the Drawings, apply a prime coat conforming to requirements of Section 32 12 13.19 - Prime Coat. Do not apply a tack coat until primed base has cured to satisfaction of Engineer.

B. Tack Coat: Conform to requirements of Section 32 12 13.13 - Tack Coat. Where the mixture will adhere to the surface on which it is to be placed without use of a tack coat, tack coat may be eliminated if approved by Engineer.

C. Prepare subgrade in advance of asphaltic concrete paving operation.

3.3 PLACEMENT

A. Do not place asphaltic mixture when air temperature is below 50 degrees F and falling. Mixture may be placed when air temperature taken in shade and away from artificial heat is above 40 degrees F and rising.

B. Haul prepared and heated asphaltic concrete mixture to the project in tight vehicles previously cleaned of foreign material. Mixture shall be at temperature between 250 degrees F and 325 degrees F when laid.

C. Spread material into place with approved mechanical spreading and finishing machine of screening or tamping type. Use track-mounted finish machine to place base course directly on earth subgrade.

D. Surface Course Material: Surface course 2 inches or less in thickness may be spread in one lift. Spread lifts in such manner that, when compacted, finished course will be smooth, of uniform density, and will be to section, line and grade as shown. Place construction joints on surface courses to coincide with lane lines or as directed by Engineer.

E. Place courses as nearly continuously as possible. Pass roller over unprotected ends of freshly laid mixture only when mixture has cooled. When work is resumed, cut back laid material to produce

slightly beveled edge for full thickness of course. Remove old material which has been cut away and lay new mix against fresh cut.

F. When new asphalt is laid against existing or old asphalt, existing or old asphalt shall be saw cut full depth to provide straight smooth joint.

G. In restricted areas where use of paver is impractical, spread and finish asphalt by mechanical compactor. Use wood or steel forms, rigidly supported to assure correct grade and cross section. Carefully place materials to avoid segregation of mix. Do not broadcast material. Remove any lumps that do not break down readily. Place asphalt courses in same sequence as if placed by machine.

3.4COMPACTION

A. Begin rolling while pavement is still hot and as soon as it will bear roller without undue displacement or hair cracking. Keep wheels properly moistened with water to prevent adhesion of surface mixture. Do not use excessive water.

B. Compress surface thoroughly and uniformly, first with power-driven, 3-wheel, or tandem rollers weighing from 8 to 10 tons. Obtain subsequent compression by starting at side and rolling longitudinally toward center of pavement, overlapping on successive trips by at least one-half width of rear wheels. Make alternate trips slightly different in length. Continue rolling until no further compression can be obtained and rolling marks are eliminated. Complete rolling before mixture temperature drops below 175 degrees F.

C. Use tandem roller for final rolling. Double coverage with approved pneumatic roller on asphaltic concrete surface is acceptable after flat wheel and tandem rolling has been completed.

D. Along walls, curbs, headers and similar structures, and in locations not accessible to rollers, compact mixture thoroughly with lightly oiled tamps.

E. Compact binder course and surface course to density not less than 93 percent of the maximum possible density of voidless mixture composed of same materials in like proportions.

3.5TOLERANCES

A. Furnish templates for checking surface in finished sections. Maximum deflection of templates, when supported at center, shall not exceed 1/8 inch.

B. Completed surface, when tested with 10-foot straightedge laid parallel to center line of pavement, shall show no deviation in excess of 1/8 inch in 10 feet. Correct any surface not meeting this requirement.

3.6FIELD QUALITY CONTROL

A. Testing will be performed under provisions of applicable Division 01 Sections.

B. Minimum of one core will be taken at random locations per 1000 feet per lane of roadway or 500 square yards of base to determine in-place depth and density.

C. In-place density will be determined in accordance with Tex-207-F and Tex-227-F from cores or sections. Other methods of determining in-place density, which correlate satisfactorily with results obtained from roadway specimens, may be used when approved by Engineer.

D. Contractor may, at his own expense, request three additional cores in vicinity of cores indicating nonconforming in-place depths. In-place depth at these locations shall be average depth of four cores.

E. Fill cores and density test sections with new compacted asphaltic concrete.

3.7 NONCONFORMING PAVEMENT

A. Recompact pavement sections not meeting specified densities or replace them with new asphaltic concrete material. Replace with new material sections of surface course pavement not meeting surface test requirements or having unacceptable surface texture. Patch asphalt pavement sections in accordance with procedures established by Asphalt Institute.

B. Remove and replace areas of asphalt found deficient in thickness by more than 10 percent. Use new asphaltic base of thickness shown on Drawings.

C. Replace nonconforming pavement sections.

3.8 UNIT PRICE ADJUSTMENT

A. Unit price adjustments shall be made for in-place depth determined by cores as follows:
   1. Adjusted Unit Price shall be ratio of average thickness as determined by cores to thickness bid upon, times unit price bid.

   2. Adjustment shall apply to lower limit of 90 percent and upper limit of 105 percent of unit price.

   3. Average depth below 90 percent may be rejected by Engineer.

3.9 PROTECTION

A. Do not open pavement to traffic until 12 hours after completion of rolling, or as shown on Drawings.

B. Maintain asphaltic concrete pavement in good condition until completion of Work.

C. Repair defects immediately by replacing asphaltic concrete pavement to full depth.

END OF SECTION 32 12 16

SECTION 32 13 13
PORTLAND CEMENT CONCRETE PAVING

PART 1 - GENERAL

1.1 DESCRIPTION

A. This Section specifies the requirements for providing, placing, curing and protecting Portland cement concrete paving, with or without reinforcement as indicated, constructed on a prepared subgrade.

1.2 QUALITY ASSURANCE

A. Reference Standards Applicable to this Section

1. ACI: American Concrete Institute

   a. 301: Specifications for Structural Concrete for Buildings.

   b. 316R: Recommendations for Construction of Concrete Pavements and Concrete Bases.

2. ASTM: American Society for Testing and Materials

   a. A 615: Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement (with Supplement + S1).

   b. C 150: Specification for Portland Cement Type I or Type II.

   c. C 309: Specification for Liquid Membrane-Forming Compounds for Curing Concrete.

   d. C 881: Specification for Epoxy-Resin-Base Bonding Systems for Concrete.

   e. D 1565: Specifications for Flexible Cellular Materials Vinyl Chloride Polymers and Copolymers (Open-Cell Foam).

   f. D 1751: Specification for Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction (Nonextruding and Resilient bituminous Types).

   g. D 1752: Specifications for Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction.

   h. D 3405: Specification for Joint Sealants, Hot-Poured, for Portland Cement Concrete Pavement.

3. TxDOT: Texas Department of Transportation.

   a. Standard Specifications for Construction of Highways, Streets, and Bridges -- Latest Edition.

      1) Item 360, CONCRETE PAVEMENT.

B. Formwork Tolerances

Formwork tolerances shall be as specified in ACI 316 R, Chapter 5.

C. Finishing Tolerance

The top surface of pavement shall have a Class B tolerance as specified in ACI 316 R, Chapter 12.5 and ACI 301, Chapter 11.9.

D. The Portland Cement Paving Contractor/Subcontractor shall provide Galveston County with evidence of his/her ability to perform the specified work. This evidence shall be in the form of at least five (5) successfully completed Portland Cement paving projects for either Galveston County or City of Dickinson.

This list of projects shall be submitted to Galveston County prior to any paving operations beginning so that Galveston County will be able to inspect the quality of workmanship at the site and approve the Contractor/Subcontractor.

1.3 SUBMITTALS

A. In accordance with Section 00 72 00 – Uniform General Conditions, Sub-Section UGC 8.3 for Texas State University System (TSUS) projects, the following shall be submitted:

1. Reinforcement Materials

   a. As required in Section 032100 - Concrete Reinforcement of these Specifications.

2. Concrete Materials

   a. As required in Sections 321373.19 - Cast-in-Place Concrete of these Specifications.

3. Joint Materials

   a. As required in Section 321319 – Concrete Pavement Joints.

1.4 EXTENDED WARRANTY

A. Manufacturer of joint sealant shall provide at least a 1 year written warranty against material degradation or failure and water and foreign matter infiltration through the joint from the time of written acceptance of the Work. This warranty shall not limit Galveston County's rights or remedies as may otherwise be afforded under law or statute.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Forms

Metal forms, as indicated in ACI 316 R, Chapter 5.

B. Welded Steel Wire Fabric

Plain wire fabric, as specified in Section 032100 - Concrete Reinforcement of these Specifications.

C. Reinforcing Steel Bars

As specified in Section 032100 - Concrete Reinforcement of these Specifications.

D. Dowel Bars

Smooth, ASTM A 615 + S1, Grade 60, new billet steel, coated with a water-resistant lubricant immediately prior to placement of concrete in which unbonded ends of bars are to be embedded.

E. Dowel Bar Sleeves

Sleeves, PVC or plastic, slightly larger than dowel bars, closed end, a minimum of 6 in. long, with 1-1/2 in. long compressible insert.

F. Concrete

Class 3000, as specified in Section 321373.19 – Cast-in-Place Concrete of these Specifications.

G. Membrane Forming Curing Compound

ASTM C 309, Type 2, unless otherwise directed.

H. Joint Materials

1. Preformed Expansion Joint Filler: ASTM D 1751, ASTM D 1752, and D 1565.

2. Joint Sealing Material: See Section 321319, Concrete Pavement Joints of these Specifications.

I. Form Coating

Commercial formulation form-coating compounds that will neither bond with, stain, nor adversely affect concrete surfaces and will not impair subsequent treatment of concrete surfaces. Contractor shall submit sample for approval prior to use.

J. Precast Concrete Wheel Stops

Accurately formed and finished, of size and shape as indicated, reinforced and anchored as required. Fabricate wheel stops on Site or substitute approved precast units of like design and dimensions.

K. Epoxy Bonding Grout

ASTM C 881, Type I.

PART 3 - EXECUTION

3.1 INSPECTION AND PREPARATION

A. Prepared subgrade shall be proof-rolled to check for unstable areas and need for additional compaction. Do not begin paving work until such deficiencies have been corrected and subgrade is ready to receive paving.

B. Loose material shall be removed from the compacted subgrade immediately prior to placing concrete and subgrade shall be uniformly dampened.

3.2 SETTING FORMS

A. Forms shall be set in accordance with the recommendations of ACI 316 R, Chapter 5, and as specified herein.

B. Forms shall be set in sufficient quantity to allow continuous progress of concrete placement, and to ensure that forms shall remain in place not less than 24 hours.

C. Forms shall be cleaned after each use and coated with an approved form release agent prior to each use.

3.3 INSTALLATION OF JOINTS, REINFORCEMENT, AND SEALANT

A. Joints and reinforcement shall be installed in accordance with the recommendations of ACI 316 R, Chapter 6, as specified in Section 032100 - Concrete Reinforcement of these Specifications, and in Section 321319 - Concrete Pavement Joints.

B. Sealant manufacturer's instructions and procedures shall be followed so as not to invalidate the warranty.

3.4 PLACING AND FINISHING CONCRETE

A. Concrete shall be placed and finished in accordance with the recommendations of ACI 316 R, Chapters 10 and 12.5, and as specified in Section 033053 - Cast-in-Place Concrete of these Specifications.

3.5 CURING AND PROTECTING CONCRETE

A. Concrete shall be cured in accordance with the recommendations of ACI 316 R, Chapter 11, using the membrane curing method and materials.

B. Protection as recommended in ACI 316 R, Chapter 11 shall be provided until written acceptance by Lone Star College.

3.6 INSTALLATION OF CONCRETE WHEEL STOPS

A. Install concrete wheel stops where indicated and in accordance with manufacturer's installation instructions as required. Where dowels are to be embedded into concrete, embed with epoxy bonding grout.

3.7 FIELD QUALITY CONTROL

A. Coring

After the pavement is placed and before final acceptance the Engineer may elect to determine pavement thickness by cores cut from the pavement or direct measurement of the edge thickness. Acceptable pavement thickness shall be deficient by no more than two tenths of an inch. Core holes shall be promptly repaired with concrete conforming to the requirements specified herein by the Contractor at no cost to Lone Star College.

B. Deficient Pavement Price Adjustments

Where the average thickness of pavement is deficient in thickness by more than 0.2 inch, but not more than 0.75 inch, payment will be made at an adjusted price as specified in the following table.

Concrete Pavement Deficiency

Deficiency in Thickness Determined by Cores Inches	Proportional Part of Contract Price Allowed
0.00 to 0.20	100 percent
Over 0.20 to 0.30	80 percent
Over 0.30 to 0.40	72 percent
Over 0.40 to 0.50	68 percent
Over 0.50 to 0.75	57 percent

Any area of pavement found deficient in thickness by more than 0.75 of an inch but not more than one inch or 1/8 of the plan thickness, whichever is greater, shall be evaluated by the Engineer. If, in the judgment of the Engineer, the area of such deficiency should not be removed and replaced, there will be no payment for the area retained. If, in the judgment of the Engineer, the area of such deficiency warrants removal, the area shall be removed and replaced, at the Contractor's entire expense, with concrete of the thickness shown on the plans. Deficient pavement shall be removed for the full area of the slab between joints, or between pre-established limits.

END OF SECTION 32 13 13

SECTION 321313.01

CONCRETE PAVING FOR PEDESTRIAN AREAS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes exterior cement concrete pavement for the following:

1. Walkways.
2. Courtyards.
3. Plazas.
4. Pedestrian Ramps.

1.2 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Design Mixtures: For each concrete pavement mixture.

C. Related Sections:

1. Section 07 92 00 “Joint Sealants” for expansion joints within pedestrian pavements

1.3 QUALITY ASSURANCE

A. Manufacturer Qualifications: Manufacturer of ready-mixed concrete products who complies with ASTM C 94/C 94M requirements for production facilities and equipment.

B. ACI Publications: Comply with ACI 301, "Specification for Structural Concrete," unless modified by requirements in the Contract Documents.

PART 2 - PRODUCTS

2.1 STEEL REINFORCEMENT

A. Plain-Steel Welded Wire Reinforcement: ASTM A-185, fabricated from as-drawn steel wire into flat sheets.

B. Deformed-Steel Welded Wire Reinforcement: ASTM A-497, flat sheet.

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

D. Plain Steel Wire: ASTM A 82, as drawn.

E. Deformed-Steel Wire: ASTM A-496.

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."

2.2 CONCRETE MATERIALS

A. Cementitious Material: Use[**one of**] the following Cementitious materials, of the same type, brand, and source throughout the Project:

1. Portland Cement: ASTM C 150, Type gray.

   a. Ground Granulated Blast-Furnace Slag: ASTM C 989, Grade 100 or 120.

2. Blended Hydraulic Cement: ASTM C 595.

B. Normal-Weight Aggregates: ASTM C 33, coarse aggregate, uniformly graded. Provide aggregates from a single source.

C. Water: ASTM C 94/C 94M.

D. Air-Entraining Admixture: ASTM C 260.

E. Chemical Admixtures: ASTM C 494/C 494M, of type suitable for application, 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.

2.3 FIBER REINFORCEMENT

A. Synthetic Fiber: Polypropylene fibers engineered and designed for use in concrete pavement, complying with ASTM C 1116, Type III, 1/2 to 1-1/2 inches long.

2.4 CURING MATERIALS

A. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth.

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

C. Water: Potable.

D. Evaporation Retarder: Waterborne, monomolecular film forming; manufactured for application to fresh concrete.

E. Clear Waterborne Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, dissipating.

F. White Waterborne Membrane-Forming Curing Compound: ASTM C 309, Type 2, Class B.

2.5 RELATED MATERIALS

A. Alternate 1: Expansion and Isolation-Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber or ASTM D 1752, cork or self-expanding cork.

B. Alternate 2: One-component polyurethane self-leveling sealant, conforming to ASTM C920, Type S, Grade P, Class 25, Use T or M, in the upper ½" depth of the joint, over the joint filler material.

C. Slip-Resistive Aggregate Finish: Factory-graded, packaged, rustproof, non-glazing, abrasive aggregate of fused aluminum-oxide granules or crushed emery with emery aggregate containing not less than 50 percent aluminum oxide and not less than 20 percent ferric oxide; unaffected by freezing, moisture, and cleaning materials.

2.6 CONCRETE MIXTURES

A. Prepare design mixtures, proportioned according to ACI 301, with the following properties:

1. Compressive Strength (28 Days): 3000 psi.

2. Maximum Water-Cementitious Materials Ratio at Point of Placement0.50.

3. Slump Limit: 4 inches, plus or minus 1 inch.

4. Air Content 5-1/2 percent plus or minus 1.5 percent.

B. Synthetic Fiber: Uniformly disperse in concrete mix at manufacturer's recommended rate, but not less than 1.0 lb/cu. yd.

C. Color Pigment: Add color pigment to concrete mixture according to manufacturer's written instructions.

2.7 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. Furnish batch certificates for each batch discharged and used in the Work.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Proof-roll prepared sub-base surface below concrete pavements with heavy pneumatic-tired equipment to identify soft pockets and areas of excess yielding.

3.2 EDGE FORMS AND SCREED CONSTRUCTION

A. Set, brace, and secure edge forms, bulkheads, and intermediate screed guides for pavement 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.

3.3 STEEL REINFORCEMENT

A. General: Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.

3.4 JOINTS

A. General: Form construction, isolation, and contraction joints and tool edgings true to line with faces perpendicular to surface plane of concrete. Construct transverse joints at right angles to centerline, unless otherwise indicated.

B. Construction Joints: Set construction joints at side and end terminations of pavement and at locations where pavement operations are stopped for more than one-half hour unless pavement terminates at isolation joints.

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.

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. If applicable, match jointing of existing adjacent concrete pavement.

E. Edging: Tool edges of pavement, gutters, curbs, and joints in concrete after initial floating with an edging tool to a 3/16-inch radius. Repeat tooling of edges after applying surface finishes. Eliminate tool marks on concrete surfaces.

3.5 CONCRETE PLACEMENT

A. Moisten sub-base to provide a uniform dampened condition at time concrete is placed.

B. Comply with ACI 301 requirements for measuring, mixing, transporting, and placing concrete.

C. 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.

D. Screed pavement surfaces with a straightedge and strike off.

E. 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.

3.6 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.

1. Burlap Finish: Drag a seamless strip of damp burlap across float-finished concrete, perpendicular to line of traffic, to provide a uniform, gritty texture.

2. 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.

3. 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.

C. Slip-Resistive Aggregate Finish: Before final floating, spread slip-resistive aggregate finish on pavement surface according to manufacturer's written instructions.

1. Cure concrete with curing compound recommended by slip-resistive aggregate manufacturer. Apply curing compound immediately after final finishing.

2. After curing, lightly work surface with a steel wire brush or abrasive stone and water to expose nonslip aggregate.

3.7 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 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 Methods: Cure concrete by moisture curing, moisture-retaining-cover curing, curing compound, or a combination of these methods.

3.8 PAVEMENT TOLERANCES

A. Comply with tolerances of ACI 117 and as follows:

1. Elevation: 1/4 inch.

2. Thickness: Plus 3/8 inch, minus 1/4 inch.

3. Surface: Gap below 10-foot long, unleveled straightedge not to exceed 1/4 inch.

4. Joint Spacing: 3 inches.

5. Contraction Joint Depth: Plus 1/4 inch, no minus.

6. Joint Width: Plus 1/8 inch, no minus.

3.9 REPAIRS AND PROTECTION

A. Remove and replace concrete pavement that is broken, damaged, or defective or that does not comply with requirements in this Section.

B. Protect concrete from damage. Exclude traffic from pavement for at least 14 days after placement.

C. Maintain concrete pavement free of stains, discoloration, dirt, and other foreign material. Sweep concrete pavement not more than two days before date scheduled for Substantial Completion inspections.

END OF SECTION 321313

SECTION 32 16 13 - CONCRETE CURBS AND CURB & GUTTER

PART 1 - GENERAL

1.1 DESCRIPTION

A. This Section specifies the requirements for providing, placing, curing, and protecting Portland cement concrete curbs, and combination curbs and gutters, constructed on a prepared subgrade.

1.2 QUALITY ASSURANCE

A. Reference Standards Applicable to this Section

1. ACI: American Concrete Institute

   a. 316R: Recommendations for Construction of Concrete Pavements and Concrete Bases.

2. ASTM: American Society for Testing and Materials

   a. A 615: Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement (with Supplement + S1).

   b. C 150: Specification for Portland Cement Type I or Type II.

   c. C 309: Specification for Liquid Membrane - Forming Compounds for Curing Concrete.

   d. D 1565: Specifications for Flexible Cellular Materials Vinyl Chloride Polymers and Copolymers (Closed Cell).

   e. D 1751: Specification for Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction (Nonextruding and Resilient bituminous Types).

   f. D 1752: Specifications for Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction.

   g. D 3405: Specification for Joint Sealants, Hot-Poured, for Portland Cement Concrete Pavement.

3. FS: Federal Specifications and Standards

   a. TT-P-86: Paint, Red-Lead-Base, Ready-Mixed.

B. Finishing Tolerance

The top surface of curbs and combination curbs and gutters shall have a Class A tolerance as specified in ACI 316 R, Chapter 12.5.

1.3 SUBMITTALS

A. In accordance with Section 00 72 00 – Uniform General Conditions, Sub-Section UGC 8.3 for Texas State University System (TSUS) projects, the following shall be submitted:

1. Reinforcement Materials

   a. As required in Section 032100 - Concrete Reinforcement of these Specifications.

2. Concrete Materials

   a. As required in Sections 321373.19 - Cast-in-Place Concrete of these Specifications.

1.4 EXTENDED WARRANTY

A. Manufacturer of joint sealant shall provide at least a 1-year written warranty against material degradation and failure and water and foreign matter infiltration through the joint from the time of written acceptance of the Work. This warranty shall not limit Galveston County's rights or remedies as may otherwise be afforded under law or statute.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Forms

Either wood or metal, of the size and shape necessary for forming the item, straight and free of warp.

B. Reinforcing Steel Bars

As specified in Section 032100 - Concrete Reinforcement of these Specifications.

C. Dowel Bars

Smooth, ASTM A 615 + S1, Grade 60, new billet steel, unbonded ends painted with red-lead-base paint, FS TT-P-86, Type I and coated with a water-resistant lubricant immediately prior to placement of concrete in which unbonded ends of bars are to be embedded.

D. Dowel Bar Expansion Caps

PVC or plastic cap, slightly larger than dowel bar, closed end, a minimum of 6 in. long, with 1-1/2 in. long compressible insert.

E. Concrete

Class 3000, as specified in Section 321373.19 – Cast-in-Place Concrete of these Specifications.

F. Membrane Forming Curing Compound

ASTM C 309, Type 2, unless otherwise directed.

G. Joint Materials

1. Preformed Expansion Joint Filler: Nonextruding and resilient bituminous type, ASTM D 1751.

2. Joint Sealing Material: See Section 321373 of these Specifications.

H. Form Coating

Commercial formulation form-coating compound that will not bond with, stain nor adversely affect concrete surfaces and will not impair subsequent treatment of concrete surfaces.

PART 3 - EXECUTION

3.1 INSPECTION AND PREPARATION

A. Prepared subgrade shall be inspected for unstable or unsuitable areas and need for additional compaction. Notify the Engineer in writing of such deficiencies. Do not begin curb construction until all such deficiencies have been corrected.

B. Loose and foreign material shall be removed from the compacted subgrade immediately prior to placing concrete, and subgrade shall be uniformly dampened.

3.2 SETTING FORMS

A. Forms shall be set to the line and grade indicated, and shall be securely staked to maintain set position during depositing and curing of concrete. The inside form shall be rigidly attached to the outside form.

B. Forms shall be set in sufficient quantity to allow continuous progress of concrete placement and to ensure that forms shall remain in place not less than 24 hours.

C. Forms shall be cleaned after each use and coated with an approved form release agent prior to each use.

3.3 INSTALLATION OF JOINTS, REINFORCEMENT, AND SEALANT

A. Reinforcement shall be installed as indicated on the Drawings and as specified in Section 032100 - Concrete Reinforcement of these Specifications. Joints shall be installed where indicated on the Drawings and in accordance with Section 321319 – Concrete Pavement Joints of these Specifications.

B. Sealant manufacturer's instructions and procedures shall be followed so as not to invalidate the warranty.

3.4 PLACING AND FINISHING CONCRETE

A. Concrete shall be placed and finished as specified in Section 033053 - Cast-in-Place Concrete of these Specifications, and ACI 316 R, Chapters 10 and 12.5.

B. After concrete has been struck off and has sufficiently set, the exposed surfaces shall be worked with a wood float. The exposed edges shall be rounded using an edging tool.

C. After form removal, the surfaces of the curb or combination curb and gutter shall be plastered with a mortar consisting of one part Portland Cement and two parts fine aggregate. Mortar shall be applied with a template constructed to the shape and dimensions of the item to be plastered. All exposed surfaces shall be brushed to a uniform smooth texture.

3.5 CURING AND PROTECTING CONCRETE

A. Concrete shall be cured in accordance with the recommendations of ACI 316 R, Chapter 11, using the membrane curing method and materials.

B. Protection as recommended in ACI 316 R, Chapter 11 shall be provided until written acceptance by the Engineer.

END OF SECTION 32 16 13

SECTION 328400

LANDSCAPE IRRIGATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Piping.
2. Manual valves.
3. Automatic control valves.
4. Automatic drain valves.
5. Sprinklers.
6. Quick couplers.
7. Controllers.
8. Boxes for automatic control valves.

1.2 PERFORMANCE REQUIREMENTS

A. Irrigation zone control shall be automatic operation with controller and automatic control valves.

B. Intent of Drawings: Sprinkler lines shown on the Drawings are diagrammatic. Locations of all sprinkler heads, valves, piping, wiring, etc. shall be established by the Contractor at the time of construction. Spacing of sprinkler heads and quick coupling valves are shown on the Drawings and shall be exceeded only with the permission of the Owner's authorized representative.

C. Keep all areas of work clean, neat, and orderly at all times. Keep paved areas clean during installation operations.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Wiring Diagrams: For power, signal, and control wiring.

C. Delegated-Design Submittal: For irrigation 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. Zoning Chart: Show each irrigation zone and its control valve.

E. Controller Timing Schedule: Indicate timing settings for each automatic controller zone.

F. Field quality-control reports.

G. Operation and maintenance data for the following:

1. Irrigation controller.
2. Valves and gate valves.
3. Pipe and fittings.
4. Valve boxes.
5. Quick coupling valves.
6. Low voltage wire and connections.

H. Record Irrigation Drawings:

1. Furnish Record Drawings of complete irrigation system in accordance with the General and Special Conditions.
2. Procure full size set of Contract Drawings from Landscape Architect.

a. Construction Drawings shall be on-site at all times while irrigation system is under construction.
b. Make daily record of all work installed each day.
c. Actual location of valves and quick couplers and all irrigation and drainage piping shall be shown on prints by dimensions from easily identifiable permanent features, such as buildings, curbs, fences, walks, or property lines.
d. Drawings shall show approved substitutions of material. Include material, manufacturer's name, and catalogue number.
e. Drawings shall be to scale and all indications shall be easily understandable, legible, and neat.

1.4 QUALITY ASSURANCE

A. Requirement of Regulatory Agencies:

1. All work and materials shall be in full accordance with the latest rules and regulations of safety orders of Division of Industrial Safety; the Uniform Plumbing Code and other applicable laws or regulations, including the City of Houston.
2. Nothing in Drawing is to be construed to permit work not conforming to these codes. Should the Contract Documents be at variance with the aforementioned rules and regulations, notify Landscape Architect and get instructions before proceeding with the work.

B. Testing:

1. Preliminary review of completed installation will be made by the Landscape Architect prior to backfilling trenches and during hydrostatic testing.

2. Final review shall be made in conjunction with the final review, shrubs, and tree planting.

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.

1.5 FINAL ACCEPTANCE

A. Work under this Section will be accepted by Landscape Architect upon satisfactory completion of all work. Upon final acceptance, Owner will assume responsibility for maintenance of the work. Said assumption does not relieve Contractor of obligations under Warranty.

1.6 WARRANTY

A. In addition to the manufacturer's guarantees or warrantees, all work shall be warranted for one year from the date of Final Acceptance against defects, material, equipment and workmanship by the Contractor. Warranty shall also cover repair of damage to any part of the premises resulting from leaks or other defect in materials, equipment, and workmanship to the satisfaction of the Owner.

B. Contractor shall not be held responsible for failures due to neglect by the Owner, vandalism, etc., during the Warranty or Guarantee period. Report such conditions to the Landscape Architect in writing.

PART 2 - <u>PRODUCTS</u>

2.1 MATERIALS

A. Materials throughout the system shall be as specified and noted on the Drawings, new and in perfect condition.

B. Gate Valves: Three inches in size and under, 125 pound bronze construction, non-rising stem type, sized to line. NIBCO #T113 or approved equal.

C. Sleeves: Control wire and water line sleeves shall be PVC 1120-1220, Schedule 40 pipe.

D. Water Meters: Per City of Houston

E. Backflow Preventer:
1. Pressure type: Manufacturer: Febco
2. Double check: Manufacturer: Febco
3. Use Pressure Type when the required elevation of the BFP is 3’-0” or less above finish grade.
4. Use Double Check Valve when the required elevation for a Pressure Type BFP is greater than 3’-0” above finish grade.

5. Protect Backflow preventer from vandalism with a lockable wire mesh cage. Manufacturer: Backflow Protection; Model: “Ultimate Tuff Cage”

F. Irrigation Controllers: Manufacturer: Base-line. Model 3200. Remote Control Valves: Manufacturer: Rainbird – Model: PEB with Baseline decoders.

G. Control Wiring: Solid copper, UL approved for direct burial in ground. Minimum gage#14 UF (#12 UF for runs over 1,000 LF). Common ground wire shall be white.

H. Valve Boxes: Injection molded of polymers and fibrous inorganic temperature resistant components. Box shall provide adequate clearance to operate and service valve. Box and lid shall be Green.

1. Acceptable Manufacturers: Amtek, Christy, Carson, or approved equal.
2. Valve boxes for remote control valves shall be rectangular, approximately 10-inch x 14-inch inside dimensions by 15 inches deep. Boxes shall be black with lockable lids and have painted on lid with 1-inch high white letters "RC".
3. B. Valve boxes for gate valves and quick couplers, shall be round, approximately 9-inch inside diameter by 10-inch deep. Boxes shall be black with lockable lids and have painted on lid with 1-inch high white letters "QC".

I. Quick Couplers:

1. Valve and keys as specified on Drawings.
2. Furnish two valve keys fitted with 3/4-inch swivel hose ells.

J. Sprinkler Heads:
1. Rotors: Hunter PGP
2. Spray Heads: Rainbird MPR

K. Conduit: All conduits for low voltage irrigation control wires shall be 2-inch Schedule 40 PVC. Control wiring may be placed in common sleeve with lateral or main lines under paving when sleeves are larger than 4-inches. Use galvanized steel pipe only under public roads or for high voltage power conductors.

2.2 PIPING

A. Piping on pressure side of irrigation control valves:

1. Two and one-half inch diameter and smaller – ASTM D 1785, PVC 1120-1220 compound, Schedule 40.

B. Piping on non-pressure side of irrigation control valves:

1. Two inch to three-quarter inch – ASTM D 1785, PVC 1120-1220, Class 200.
2. One-half inch and smaller – ASTM D 1785, PVC 1120-1220, Class 315.

C. Identification: Continuously and permanently marked with manufacturer's name or trademark, size, schedule and type of pipe, working pressure at 73 degrees F., and National Sanitation Foundation (NSF) approval.

2.3 FITTINGS

A. Fittings for Solvent- Welded Pipe:

1. Schedule 40, polyvinyl chloride, standard weight, as manufactured by "Sloane", "Lasco", or approved equal, to meet ASTM D-2466-73 and D-2467-73.
2. Threaded PVC nipples - Schedule 80 PVC.

B. Fittings for Polyethylene Pipe:

1. Polyallomer as manufactured by "Flintkote" or approved equal.
2. Compression type of CPVC as manufactured by "Pepco".

C. Fittings for Swing Joints:

1. Supply three (3) Schedule 40 "Marlex" elbows.
2. Threaded PVC Nipples - Schedule 80 PVC.

2.4 PIPING JOINING MATERIALS

A. Solvent Cements for Joining PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.

B. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer unless otherwise indicated.

PART 3 - <u>EXECUTION</u>

3.1 EXAMINATION

A. Site Verification of Conditions:

1. Contractor shall be acquainted with all site conditions. Should utilities or other work not shown on the plans be found during excavations, Contractor shall promptly notify Landscape Architect for instructions as to further action. Failure to do so will make Contractor liable for any and all damage arising from operations subsequent to discover of such utilities not shown on plans.
2. Contractor shall take necessary precautions to protect site conditions. Should damage be incurred Contractor shall repair damage to its original condition or furnish and install equal replacement.

3.2 LAYOUT

A. Consideration will not be given to design changes until after award of contract.

B. Lay out work as closely to that shown on the Contract Drawings as possible. Contract Drawings are diagrammatic in nature. Adjust layout as necessary to accommodate actual site conditions. Locate pipe and valves shown under paving in adjacent planting area.

C. Full and complete coverage is required. Contractor shall make minor adjustments to layout as required to assure full and complete coverage. When such adjustments require exceeding radius limitations shown on irrigation legend, contact Landscape Architect for direction.

D. Substitutions for smaller pipe sizes will be not be accepted.

3.3 EARTHWORK

A. Perform excavation as required for installation of work included under this Section, including shoring of earth banks if necessary. Restore all surfaces, existing underground installations, etc., damaged or cut as a result of excavations, to their original condition.

B. Should utilities not shown on the plans be found during excavation, promptly notify Landscape Architect for instructions as to further action. Failure to do so will make Contractor liable for any and subsequent discovery of such utilities. Indicate such utility crossings on the Record Drawings promptly.

C. Dig trenches wide enough to allow a minimum of 4-inches between parallel pipe lines. Trenches shall be of sufficient depth of proved minimum cover from finish grade as follows:

1. Over pipe on pressure side of irrigation control valve, control wires and quick coupling valves: 18 inches.
2. Over pipe on non-pressure side of irrigation control valve: 12 inches.

D. Trenching within the drip-line of existing trees shall not employ the use of mechanical trenching devices. Hand dig without severing roots which exceed 1-1/2” in diameter. Notify the Landscape Architect immediately if site conditions prohibit such action.

3.4 PIPING INSTALLATION

A. General:

1. Location and Arrangement: Drawings indicate location and arrangement of piping systems. Install piping as indicated unless deviations are approved on Coordination Drawings.
2. Clean all pipes and fittings of dirt and moisture before assembly.
3. Install piping free of sags and bends.
4. Install groups of pipes parallel to each other, spaced to permit valve servicing.
5. Install fittings for changes in direction and branch connections.

6. Install unions adjacent to valves and to final connections to other components with NPS 2 (DN 50) or smaller pipe connection.
7. Install flanges adjacent to valves and to final connections to other components with NPS 2-1/2 (DN 65) or larger pipe connection.
8. Install expansion loops in control-valve boxes for plastic piping.
9. Lay piping on solid sub-base, uniformly sloped without humps or depressions.
10. Install ductile-iron piping according to AWWA C600.
11. Install PVC piping in dry weather when temperature is above 40 deg F. Allow joints to cure at least 24 hours at temperatures above 40 deg F before testing.

B. Solvent-Welded Joints for PVC Pipes:

1. Use solvents and methods by pipe manufacturer
2. Cure joint a minimum of one hour before applying any external stress on the piping and at least twenty four (24) hours before placing the joint under water pressure.

C. Threaded Joints for Plastic Pipes:

1. Use Teflon tape on the threaded PVC fittings except where Marlex fittings are used.
2. Use strap-type friction wrench only. Do not use metal-jawed wrench.
3. When connection is plastic to metal, male adaptors shall be used. The male adaptor shall be hand tightened, plus one turn with a strap wrench. Joint compound shall be Teflon tape or approved equal.

D. Joints for Polyethylene Pipes:

1. Double-clamp all connections 1-1/4-inch diameter and greater.
2. Make all connections between polyethylene pipes and metal valves or pipes with threaded fittings using male adaptors.

E. Laying of Pipe:

1. Pipes shall be bedded in at least 2-inches of finely divided material with no rocks or clods over 1-inch diameter to provide a uniform bearing.
2. Pipe shall be snaked from side to side of trench bottom to allow for expansion and contraction. One additional foot per 100 feet of pipe is the minimum allowance for snaking.
3. PVC Pipe shall not be laid when there is water in the trench.
4. Install plastic pipe in a manner to provide for expansion and contraction as recommended by the manufacturer.
5. Cut plastic pipe with PVC pipe cutters or hacksaw to ensure a square cut. Remove burrs at cut ends prior to installation to ensure that a smooth unobstructed flow will be obtained.
6. All plastic to plastic joints shall be solvent-weld joints or slip seal joints. Only solvent recommended by the pipe manufacturer shall be used. Install plastic pipe and fittings as outlined and instructed by pipe manufacturer. It shall be the Contractor's responsibility to make arrangements with the pipe manufacturer for any field assistance that may be necessary. Contractor shall assume full responsibility for the correct installation.

3.5 EQUIPMENT INSTALLATION

A. Gate Valves: Group valves together and locate in planted areas where possible. Box shall be flush with finish grade.

B. Irrigation Control Valves: Install control valves in valve boxes where shown and group together where practical. Place no closer than 12-inches to walk edges, buildings, and walls. Valve boxes shall be flush with finish grade.

C. SPRINKLER HEADS:

1. Place all rotary pop-up sprinkler heads in lawn areas on swing joints as Detailed on Drawings with top of heads 1-Inch above finish grade. Place part-circle rotary pop-up sprinkler heads 8-inches from edge of and flush with top of adjacent walks, header boards, curbs, mowing bands, or paved areas at time of installation. Install rotary sprinklers on a swing joint assembly as detailed.
2. Install spray heads and bubbler heads on a swing joint assembly as detailed on the Drawings.

D. Quick Coupling Valves: Install quick coupling valves on a swing joint assembly as detailed on the Drawings.

E. Automatic Controller:

1. Install per local code and manufacturer's latest printed instructions.
2. Connect remote control valves to controller in clockwise sequence to correspond with station setting beginning with Stations 1, 2, 3, etc.
3. Affix controller name (i.e. "Controller A") on inside of controller cabinet door with letters minimum of 1-inch high.
4. Affix a non-fading copy of irrigation diagram to cabinet door below controller name. Seal irrigation diagram between two sheets of 20 mil (minimum) plastic.
5. Irrigation diagram shall be a reduced copy of the as-built drawing and shall show clearly all valves operated by the controller, showing station number, valve size, and type of planting irrigated.

F. Control Wiring:

1. Install control wires with sprinkler mains and laterals in common trenches wherever possible. Lay to the side of pipe line. Provide looped slack at valves and snake wires in trench to allow for contraction of wires. Tie wires in bundles at ten (10') foot intervals.
2. Crimp and seal control wire splices at remote control valves with specified splicing materials. Line splices will be allowed only on runs of more than 500 feet. Line splices to be Scotchlok and sealed with Scotchkote sealer.
3. Install a minimum of one (1) extra control wire to the control valve located the greatest distance from the controller in both directions and label each end blank or as shown on drawings.

G. Closing of Pipe and Flushing of Lines:

1. Cap or plug all openings as soon as lines have been installed to prevent entrance of materials that would obstruct the pipe. Leave in place until removal is necessary for completion of installation.
2. Thoroughly flush out all water lines before installing heads, valves and other hydrants.
3. Test as specified.
4. Upon completion of testing, complete assembly and adjust sprinkler heads for proper distribution.
5. All sprinkler heads and quick coupling valves shall be set perpendicular to finished grades unless otherwise designated on the Drawings, or otherwise specified. Sprinkler heads adjacent to existing walls, curbs and other paved areas, shall be set to grade. Sprinkler heads which are to be installed in lawn areas where the turf has not yet been established shall be set 1-inch above the proposed finish grade. Heads installed in this manner will be lowered to grade when the turf is sufficiently established to allow walking on it without appreciable destruction. Such lowering of heads shall be done by Contractor as part of the original contract with no additional cost to the Owner.

3.6 BACKFILL AND COMPACTING:

A. After system is operating and required tests and inspections have been made, backfill excavations and trenches with clean soil free of debris.

B. Backfill for all trenches, regardless of the type of pipe covered, shall be compacted to minimum 95 percent density under pavements, and 85 percent under planted areas.

C. Compact trenches in areas to be planted by thoroughly flooding backfill. Jetting process may be used in those areas.

D. Dress off all areas to finish grades.

3.7 GUARANTEE

A. The Contractor shall warrant all materials and workmanship for one (1) year from final acceptance.

3.8 CLEAN UP

A. Clean up and remove all debris from the entire work area prior to Final Acceptance to satisfaction of Landscape Architect.

3.9 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Perform hydrostatic tests when welded PVC joints have cured per manufacturer's instructions.

1. Pressurized Mains:

a. Completely install mains, gate valves, and control valves. Do not install laterals.
b. Fill all lines with water.
c. Pressurize the main with air to 70 psi. Monitor gauge for pressure loss for four (4) hours. Maximum allowable loss over four (4) hour period - 3 psi.
d. Leave lines and fittings exposed throughout testing period.
e. Leaks resulting from tests shall be repaired and tests repeated until the system passes.
f. Test all gate valves for leakage.

2. Non-Pressure Laterals:

a. Test piping after laterals and risers are installed and system is fully operational.
b. Leave trenches open to detect possible leaks.

C. Submit written requests for inspections to the Landscape Architect at least forty eight (48) hours prior to anticipated inspection date.

D. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.

1. Operational Test: After electrical circuitry has been energized, operate controllers and automatic control valves to confirm proper system operation.
2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

E. Any irrigation product will be considered defective if it does not pass tests and inspections.

F. Prepare test and inspection reports.

3.10 ADJUSTING

A. Adjust settings of controllers.

B. Adjust automatic control valves to provide flow rate at rated operating pressure required for each sprinkler circuit.

C. Adjust sprinklers and devices, except those intended to be mounted aboveground, so they will be flush with, or not more than 1/2 inch above, finish grade.

END OF SECTION 328400

SECTION 329119

LANDSCAPE GRADING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes prevention of excessive weed growth in lawns.

B. Related Sections:

1. Section 328400 – Planting Irrigation.
2. Section 329113 – Soil Preparation.
3. Section 329200 – Turf and Grasses.

1.2 DEFINITIONS

A. Finished Grading: Placing and grading of additional soil that may be required to bring the grade to the required grades for lawns, shrubbery, and groundcover beds.

B. Additional Fill Materials: Topsoil as specified herein unless otherwise specified.

1.3 PROJECT CONDITIONS

A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during site-preparation 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 authorities having jurisdiction.
3. Minimize use of heavy machinery where practicable.

1.4 QUALITY ASSURANCE

A. Qualifications: Work shall be performed by personnel trained and experienced in the work and shall be done under the direct supervision of a superintendent on Contractor's staff.

B. Workmanship: Perform work in conformance with recognized acceptable practices. Where job requirements require deviation from those practices, obtain approval from Landscape Architect before processing.

1.5 EXISTING CONDITIONS

A. Protection of Existing Utilities:

1. Existence and location of underground items are not guaranteed. Investigate and field verify before starting work. Excavation and backfill in the vicinity of existing items of work shall be carried out with extreme caution.
2. Contractor shall be held responsible for any damage and for maintenance and protection of existing utilities.
3. Indicate on record drawings where there is conflict between field conditions and drawings.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Topsoil: Topsoil shall be free from herbicides and insecticides which might adversely affect subsequent growth of turf or plantings, or which might otherwise contain materials toxic to humans and pets.

B. Sand: Required product shall be "Bank Sand". Submit sample for approval. Sand is not permitted for fine grading purposes if depth exceeds 3/4 inches to achieve finished grade.

2.2 EQUIPMENT

A. Machinery: Machinery shall be approved by Owner. Contractor shall provide equipment and machinery sufficient for proper execution of Work.

PART 3 - EXECUTION

3.1 PREPARATION

A. Protect and maintain benchmarks and survey control points from disturbance during construction.

B. Protect existing site improvements to remain from damage during construction.

1. Restore damaged improvements to their original condition, as acceptable to Owner.

3.2 TREE PROTECTION

A. Erect and maintain temporary fencing around tree protection zones before starting site clearing. Remove fence when construction is complete.

B. Do not excavate within tree protection zones, unless otherwise indicated.

C. Repair or replace trees and vegetation indicated to remain that are damaged by construction operations, in a manner approved by Architect.

3.3 UTILITIES

A. Locate, identify, disconnect, and seal or cap off utilities indicated to be removed.

1. Arrange with utility companies to shut off indicated utilities.

B. 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 Landscape Architect not less than two weeks in advance of proposed utility interruptions to allow conformance with Utility Department Outage Notification protocol.

3.4 FINISH GRADING

A. In areas to receive lawns, till, disc, or otherwise scarify soil removing all clods, stones, and related material one inch or larger. Place and spread any additional material that may be required.

B. Landscape areas shall have 2% minimum slope for good drainage. Contractor shall be responsible for minor adjustments to finished subgrade if deemed required by Landscape Architect.

C. Hand rake surface, removing all clods and undesirable material greater than one-half inch from ground surface. Fill all low spots and cut irregularities to the acceptance of the Landscape Architect.

D. Finish all swales and additional swales that may be required to drain areas where there are existing plant materials during finished grading operations.

E. Prepare to immediately begin grassing operations of the completed and accepted finish grade to prevent excessive weed growth in lawn areas.

3.5 DISPOSAL

A. Disposal: 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.

1. Separate recyclable materials produced during site clearing from other nonrecyclable materials. Store or stockpile without intermixing with other materials and transport them to recycling facilities.

END OF SECTION 329119

SECTION 329202

SODDING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Sodding.

1.2 REFERENCES

A. Hortus III – 1976 Edition, Bailey Hortorium, Cornell University.

B. Guideline Specifications to Turfgrass Sodding – 1995 Edition, By Turfgrass Producers International

1.3 DEFINITIONS

A. Finish Grade: Elevation of finished surface of planting soil.

B. Manufactured Soil: Soil produced off-site by homogeneously blending mineral soils or sand with stabilized organic soil amendments to produce topsoil or planting soil.

C. Planting Soil: Native or imported topsoil, manufactured topsoil, or surface soil modified to become topsoil; mixed with soil amendments.

D. Subgrade: Surface or elevation of subsoil remaining after completing excavation, or top surface of a fill or backfill immediately beneath planting soil.

E. Subsoil: All soil beneath the topsoil layer of the soil profile, and typified by the lack of organic matter and soil organisms.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Certification of grass sod.

1. Certification of each seed mixture for turfgrass sod.

C. Product certificates.

D. Planting Schedule: Indicating anticipated planting dates for each type of planting.

1.5 QUALITY ASSURANCE

A. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on Project site when planting is in progress.

B. Topsoil Analysis: Furnish soil analysis by a qualified soil-testing laboratory.

1. Report suitability of topsoil for lawn growth. State-recommended quantities of nitrogen, phosphorus, and potash nutrients and soil amendments to be added to produce satisfactory topsoil.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Sod: Harvest, deliver, store, and handle sod according to requirements in TPI's "Specifications for Turfgrass Sod Materials" and "Specifications for Turfgrass Sod Transplanting and Installation" in its "Guideline Specifications to Turfgrass Sodding." Deliver sod in time for planting within 24 hours of harvesting. Protect sod from breakage and drying.

1.7 PROJECT CONDITIONS

A. Do not install lawns during rainy or freezing weather, or when soil is frozen.

1.8 TIMING OF INSTALLATION

A. Sod:

1. Immediately after finish grading is accepted.

2. Allow sufficient time for sod to knit together and meet requirements for preliminary review.

1.9 WARRANTY

A. Time Period: Warrant that lawns are in healthy and flourishing condition of vigroious active growth one year from date of Final Acceptance.

B. Appearance During Warranty: Lawns shall be free of dead or dying patches, and all areas shall show foliage of a normal density, size and color.

C. Delays: Delays caused by the Contractor in completing planting operations which extend the planting into more than one planting season shall extend the Warranty Period correspondingly.

D. Exceptions: Contractor shall not be held responsible for failures due to neglect by Owner, vandalism, or Acts of God during Warranty Period. Report such conditions in writing.

1.10 MAINTENANCE SERVICE

A. Initial Lawn Maintenance Service: Provide full maintenance by skilled employees of landscape Installer. Maintain as required in Part 3. Begin maintenance immediately after each area is planted and continue until acceptable lawn is established, but for not less than the following periods:

1. Seeded Lawns: 60 days from date of planting completion.

   a. When initial maintenance period has not elapsed before end of planting season, or if lawn is not fully established, continue maintenance during next planting season.

2. Sodded Lawns: 30 days from date of planting completion.

PART 2 - <u>PRODUCTS</u>

2.1 LAWN SOD

A. One year old nursery-grown sod that is certified Common Bermuda.

B. Dense, healthy, field-grown on fumigated soil with the grass having been mowed at 1-inch height before lifting from field.

C. Dark green in color, free of thatch, free from diseases, weeds and harmful insects.

D. Reasonably free of objectionable grassy and broad leaf weeds. Sod shall be considered weed free if no more than ten (10) such weeds are found per 100 sq. ft. of sod.

E. Sod shall be rejected if found to contain the following weeds:

1. Quackgrass.

2. Johnson grass.

3. Poison ivy.

4. Nimbleweed.

5. Thistle.

6. Bindweed.

7. Bentgrass.

8. Perennial sorrel.

9. Bromegrass.

F. All sod to be cut 1-1/2 inches deep. Rhizome development should be apparent.

2.2 GENERAL ACCESSORIES

A. Water: Potable water as furnished by Owner.

B. Pre-plant Fertilizer: See Soil Preparation - Section 329113

C. Top-Dress Fertilizer: 16-6-8 (N-P-K)

D. Herbicides: Do not use herbicides which persist in the ground longer than 30 days.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verification of Conditions:

1. Grades: Verify that grades are within 1-inch plus or minus the required finished grades. Verify that all soil preparation has been completed and approved. Report all variations in writing.

2. Stones, Weeds, Debris: Verify that all areas to receive lawns and grasses are clear of stones larger than 1-1/2 inch in diameter, weeds, debris, and other extraneous materials.

3.2 PREPARATION

A. Moisten prepared lawn areas before planting if soil is dry. Water thoroughly and allow surface to dry before planting. Do not create muddy soil.

B. Before planting, restore areas if eroded or otherwise disturbed after finish grading.

3.3 SODDING

A. Sod Bed Preparation:

1. Rolling: Roll amended soil with 200 pound water-ballast roller.

2. Moistening Soil Surface: After all unevenness in the soil surface has been corrected, lightly moisten the soil immediately prior to laying the sod.

3. Timing: Sod immediately thereafter, provided the sod bed has remained in friable condition.

B. Sodding Operations :

1. Big roll sod shall be installed by tractors with proper flotation tires of by an approved big roll sod installation machine. Care should be taken to roll out sod at a proper speed so that no humping or tearing of sod occurs. Sod will be manually pulled together by stiff rakes to insure no gaps remain in the seams. Joints should be staggered. Damaged or problem areas shall be cut out and replaced in a professional matter.

2. Starter Strip:

   a. Lay first row of sod in a straight line, with subsequent rows parallel to and tightly against each other.

   b. Stagger lateral joints.

   c. Do not stretch or overlap sod.

   d. Butt all joints tightly to eliminate all voids.

3. Cutting: Use a sharp knife to cut sod to fit curves, surface components of the irrigation system or other items.

4. Tamping and Rolling: Thoroughly tamp and roll sod to make contact with sod bed. Roll each entire section of completed sod.

5. Watering: Thoroughly water sod immediately after installation to wet the underside of the new sod pad and the soil immediately below to a depth of 6 inches. Maintain constant moisture for 2 weeks or until sod is fully rooted.

6. Top-Dress Fertilizer: Apply at the rate of (6) to (8) pounds per 1,000 square feet at 25 days and at 50 days after sodding.

3.4 LAWN MAINTENANCE

A. Maintain and establish lawn by watering, fertilizing, weeding, mowing, trimming, replanting, and other operations. Roll, re-grade, and replant bare or eroded areas and re-mulch to produce a uniformly smooth lawn. Provide materials and installation the same as those used in the original installation.

B. Mow lawn as soon as top growth is tall enough to cut. Repeat mowing to maintain specified height without cutting more than 1/3 of grass height. Remove no more than 1/3 of grass-leaf growth in initial or subsequent mowing.

3.5 SATISFACTORY LAWNS

A. Satisfactory Sodded Lawn: At end of maintenance period, a healthy, well-rooted, even-colored, viable lawn has been established, free of weeds, open joints, bare areas, and surface irregularities.

B. Use specified materials to reestablish lawns that do not comply with requirements and continue maintenance until lawns are satisfactory.

3.6 FIELD QUALITY CONTROL

A. Tests: Samples of materials may be taken and tested for conformity to specifications at any time.

B. Rejected Materials: Remove rejected materials immediately from site at Contractor's expense. Pay cost of testing of materials not meeting specified requirements.

3.7 CLEANING

A. Erosion: Immediately restore eroded areas. Keep all adjacent paved surfaces clear of dirt, mud, stains, and organic debris.

END OF SECTION 329200

SECTION 32 92 13 - HYDROMULCH SEEDING

PART 1 GENERAL

1.1 SCOPE

A. Refer to the Drawings, Schedules and Details for type and locations of work required herein. Furnish all labor, materials, equipment and supervision for the installation of items included within these specifications. Such work includes, but is not limited to the following:

1. Furnishing and applying hydromulch seeding including all materials and equipment required for the specified method of lawn installation.

2. Site cleanup.

3. Maintenance and guarantee.

1.2 APPLICABLE PUBLICATIONS

A. The following publications of the latest issues listed below, but referred to thereafter by basic designation only, form a part of this specification to the extent indicated by references thereto:

1. Texas Department of Transportation 2004 Standard Specifications for construction of Highways, Street and Bridges (TxDOT).

a. Item 162 - Sodding for Erosion Control

b. Item 164 - Seeding for Erosion Control

1.3 RELATED WORK

A. Section 31 22 13 - Site Grading.

B. Section 31 25 13 - Erosion and Sedimentation Control

C. Section 32 92 00 Turf and Grasses

1.4 QUALITY ASSURANCE

A. Requirements of Regulatory Agencies:

1. Perform Work in accordance with all applicable laws, codes, and regulations required by authorities having jurisdiction over such work and provide for all inspections and permits required by Federal, State, and local authorities in furnishing, transporting, and installing materials.

1.5 SUBMITTALS

A. Samples:

1. The Owner reserves the right to request samples of materials for conformity to specifications at any time. Contractor shall furnish samples upon request. Rejected

materials shall be immediately removed from the site at Contractor's expense. Cost of replacement of materials not meeting the specifications shall be paid by Contractor.

2. Typical requests from the owner may include copies of manufacturers' literature, certifications, or laboratory analytical data for the following items:

a. Fibre Mulch.

b. Tank Mix Fertilizer.

c. Top Dress Fertilizer.

1.6 SCHEDULE

A. Submit a proposed work schedule to the Owner for approval at least fifteen (15) days prior to start of work under this Section. After approval, no modification shall be made to this schedule without written authorization by the Owner.

B. In general, the work shall proceed as rapidly as the site becomes available, consistent with normal seasonal limitations for planting work.

1.7 PRODUCT DELIVERY, HANDLING AND STORAGE

A. Furnish standard products in manufacturer's standard containers bearing original labels showing quantity, analysis and name of manufacturer.

B. Submit written requests for inspections to the Engineer at least seven (7) days prior to anticipated inspection date.

PART 2 - MATERIALS

2.1 SEED

A. All seed used shall be labeled in accordance with U.S. Department of Agriculture Rules and Regulations under the Federal Seed Act in effect on the date of Invitation for Bids. All seed shall be furnished in sealed standard containers unless exception is granted in writing by the Engineer. Seed which has become wet, moldy, or otherwise damaged in transit or in storage will not be acceptable. The minimum percentage by weight or pure live seed in each lot of seed shall be as follows and seed shall be planted at the rate per acre indicated under pure live seed required per acre.

Kind of Seed	Minimum % Pure Live Seed Required	Pounds Pure Live Seed Required Per Acre
Bermuda Grass	85	7
K.R. Bluestem	85	1
Bahiagrass (Pensacola)	85	9

Note: % Pure Live Seed = (% Purity) X (% Germination)

B. Weed seed shall not exceed ten (10%) of weight of the total of pure live seed and other material in the mixture. Johnson grass, nut grass, or other noxious weed seed will not be allowed.

C. Source - Quality Control

1. Seed: The Contractor must follow the Federal Seed Act with respect to interstate commerce and transportation. Each lot of seed may be re-sampled and retested in accordance with latest Rules and Regulations under the Federal Seed Act at the discretion of the Owner. The seed retests will be conducted by a testing laboratory allowed by the State of Texas Department of Agriculture Seed Control Office. Material found to be below specified content levels will be at the contractor's responsibility to correct by removing and replanting and/or additional plantings.

2.2 FERTILIZER FOR TANK MIX

A. Shall be 13-13-13 grade, pelleted, uniform on composition, free-flowing, and suitable for application with approved equipment. The fertilizer shall be delivered to the site in bags or other convenient containers, each fully labeled, conforming to the applicable state fertilizer laws, and bearing the name or trademark and warrant of the producer.

2.3 WOOD CELLULOSE FIBER MULCH

A. Wood Cellulose fiber mulch, for use with the hydraulic application of grass seed and fertilizer, shall consist of specially prepared wood cellulose fiber. It shall be processed in such a manner that it will not contain germination of growth inhibiting factors. It shall be dyed a green color to allow visual metering of its application. The wood cellulose fibers shall have the property of becoming evenly dispersed and suspended when agitated in water. When sprayed uniformly on the surface of the soil, the fibers shall form a blotter-like groundcover which readily absorbs water and allows infiltration to the underlying soil. Weight specifications from suppliers for all applications shall refer only to air dry weight of the fiber, a standard equivalent to eighteen (18%) percent moisture. The mulch material shall be supplied in packages having a gross weight not in excess of 100 pounds and be marked by the manufacturer to show the dry weight content. Suppliers shall be prepared to certify that laboratory and field testing of their product has been accomplished and that meets all of the foregoing requirements.

2.4 WATER

A. Water used for mixing or curing shall be reasonably clean and free of oil, salt, acid, alkali, sugar, vegetable matter or other substances injurious to the finished product.

B. Water sources other than the local municipal domestic water supply must be approved by the Owner.

1. If onsite reclaimed water sources are used, tanks and apprentices must be clearly marked with the words "non-potable" water.

2.5 SLURRY MIX COMPONENTS PER ACRE

A. Wood Cellulose Fiber Mulch = 2,000 pounds

B. Grass Seed = (as specified)

C. Fertilizer (13-13-13) = 800 pounds

2.6 TOP DRESS FERTILIZER

A. (Delayed Application) Complete fertilizer, fifty (50%) percent of the nitrogen to the derived from natural organic sources or urea-form. Available phosphoric acid shall be from

superphosphate, bond, or tankage. Potash shall be derived from muriate of potash containing sixty (60%) percent potash:

1. 16% Nitrogen

2. 6% Phosphoric Acid

3. 8% Potash

PART 3 - EXECUTION

3.1 HYDROMULCH SEEDING ON PREPARED FINISHED GRADE

A. Bed Preparation: Immediately after the finished grade has been approved, begin hydroseeding operation to reduce excessive weed growth.

B. Special Mulching Equipment and Procedures: Hydraulic equipment used for the application of fertilizer, seed, and slurry of prepared wood fiber mulch shall have a built-in agitation system with an operating capacity sufficient of agitate, suspend, and homogeneously mix a slurry containing up to forty (40) pounds of fiber plus a combined total of seventy (70) pounds of fertilizer solids for each one hundred (100) gallons of water. The slurry distribution lines shall be large enough to prevent stoppage. The discharge line shall be equipped with a set of hydraulic spray nozzles which provide even distribution of the slurry on the slopes to be seeded. The slurry tank shall have a minimum capacity of eight hundred (800) gallons and shall be mounted on a traveling unit which may be either self-propelled or drawn with a separate unit which will place the slurry tank and spray nozzles within sufficient proximity to the areas to be seeded so as to provide uniform distribution without waste. The Engineer may authorize equipment with smaller tank capacity provided that the equipment has the necessary agitation system and sufficient pump capacity to spray the slurry in a uniform coat.

C. Mixing: Care shall be taken that the slurry preparation should be accomplished per the material supplier's recommendations and the equipment manufacturer's written operations manual. Spraying shall commence immediately when the slurry is mixed and the tank is full. The operator shall spray the area with a uniform, visible coat by using the green color of the wood pulp as a guide.

D. Application:

1. Contractor shall obtain approval of hydromulch area preparation from the Engineer prior to application.

2. Operators of hydromulching equipment shall be thoroughly experienced in this type of application. Apply specified slurry mix in a motion to form a uniform mat at specified rate.

3. Keep hydromulch within areas designated and keep from contact with other plant material.

4. Slurry mixture which has not been applied within four (4) hours of mixing shall not be used and shall be removed from the site.

5. After application, the Contractor shall not operate any equipment over the covered area.

6. Immediately after application, thoroughly wash off any plant material, planting areas, or paved areas not intended to receive slurry mix. Keep all paved and planting areas clean during maintenance operations.

7. Refer also to the maintenance portion of this section.

8. All areas designed on drawings shall be covered uniformly with specified materials using hydromulching processes. If surfaces remain uncovered within the designated area, the Contractor shall seed with required grasses or ground cover materials those areas missed by the hydromulch application. Method used to seed these missed surfaces shall be an alternate seeding operation approved by the Architect/Engineer/Owner's Representative and shall be accomplished at no additional cost to the Owner.

3.2 CLEAN UP

A. Keep all areas of work clean, neat, and orderly at all times. Keep all paved areas clean during installation operations. Clean up and removal all deleterious materials and debris from the entire work area prior to Final Acceptance to the satisfaction of Engineer.

3.3 INSPECTIONS

A. Make written request for inspection prior to seeding and after areas have been seeded.

B. Submit requests for inspections to Engineer at least two (2) days prior to the anticipated inspection date.

3.4 MAINTENANCE BY THE CONTRACTOR

*A. The Contractor shall begin maintenance after each plant is installed and continue until Final Acceptance. *[OR]

*A. The Contractor's Maintenance Period shall begin upon inspection and approval at Substantial Completion and shall be for the period of 60 days.

B. The Contractor's maintenance of new planting shall consist of watering, weeding, repair of all erosion and reseeding and resodding as necessary to establish a uniform stand of the specified grasses. Contractor shall guarantee growth and coverage of hydromulch planting under this Contract to the effect that a minimum of ninety five (95%) percent of the area planted will be covered with specified planting after sixty (60) days with no bare spots greater than ten (10) square feet. Any sod panels that are dead or dying shall be replaced.

C. The Contractor shall be responsible for one (1) mowing in the event that the time between seeding or sodding and Final Acceptance exceeds thirty (30) days.

D. Contractor shall make a second application of specified hydromulch planting to bare areas not meeting specified coverage as determined by the Engineer. Such replanting to be performed within sixty (60) days of initial application and immediately upon notification by Engineer to replant.

E. Apply top dress fertilizer (16-6-8) at the rate of ten (10) pounds per 1,000 square feet at no less than nor more than twenty five (25) days after seeding unless approved in writing by the Owner.

3.5 FINAL ACCEPTANCE

A. Work under this Section will be accepted by Engineer upon satisfactory completion of all work, but exclusive of re-application under the Guarantee Period. Final Acceptance of lawn establishment shall be as follows:

B. For Seed: Ninety Five (95%) percent uniform coverage of grass in excess of one (1") inch height. No bare spots of greater than two (2) square feet will be accepted.

C. The Engineer and/or Owner shall interpret the above. Upon Final Acceptance, the Owner will assume the responsibility for maintenance of the work.

END OF SECTION

SECTION 329313

TREES, SHRUBS, AND GROUNDCOVER

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Trees.
2. Shrubs.
3. Ground cover.

1.2 REFERENCES

A. "Grades and Standards", latest edition, Texas Association of Nurserymen Specifications, Austin, Texas 78704.

B. "American Standard for Nursery Stock", American National Standards Institute, Incorporated, (ANSI Z 60).

C. "Standardized Plant Names", 1942 Edition, American Joint Committee on Horticultural Nomenclature

1.3 DEFINITIONS

A. Backfill: The earth used to replace or the act of replacing earth in an excavation.

B. Finish Grade: Elevation of finished surface of planting soil.

C. Manufactured Topsoil: Soil produced off-site by homogeneously blending mineral soils or sand with stabilized organic soil amendments to produce topsoil or planting soil.

D. Planting Soil: Native or imported topsoil, manufactured topsoil, or surface soil modified to become topsoil; mixed with soil amendments.

E. Subgrade: Surface or elevation of subsoil remaining after completing excavation, or top surface of a fill or backfill, before placing planting soil.

F. Subsoil: All soil beneath the topsoil layer of the soil profile, and typified by the lack of organic matter and soil organisms.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated provide requested copies of manufacturers literature, samples, certifications, and laboratory analytical data:
   1. Trees, shrubs, and groundcovers – Samples and/or photographs.
   2. Mulch – manufacturer's literature and sample.
   3. Tree and shrub planting fertilizer – certification or laboratory analytical data.
   4. Tree paint – manufacturer's literature.

B. Product certificates.

C. Planting Schedule: Indicating anticipated planting dates for exterior plants.

D. Maintenance Instructions: Recommended procedures to be established by Owner for maintenance of exterior plants during a calendar year.

1.5 QUALITY ASSURANCE

A. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on Project site when planting is in progress.

B. Topsoil Analysis: Furnish soil analysis by a qualified soil-testing laboratory.

   1. Report suitability of topsoil for plant growth. State-recommended quantities of nitrogen, phosphorus, and potash nutrients and soil amendments to be added to produce satisfactory topsoil.

C. Provide quality, size, genus, species, and variety of exterior plants indicated, complying with applicable requirements in ANSI Z60.1, "American Standard for Nursery Stock."

D. Source - Quality Control:
   1. Plants shall be subject to inspection and approval by Landscape Architect at place of growth and upon delivery for conformity to specifications. Such approval shall not impair the right of inspection and rejection during progress of the Work. Submit written request for inspection of plant material at place of growth to Landscape Architect. Written request shall state the place of growth and quantity of plants to be inspected. Landscape Architect reserves right to refuse inspection at this time if a sufficient quantity of plants is not available for inspection. All plant material shall be tagged by the Landscape Architect at the nursery.
   2. All plants inspected at the nursery by the Landscape Architect shall be tagged with serialized self-locking tags. Trees delivered to the site without these tags or with broken tags shall be sufficient reason for rejection.
   3. Substitutions of plant materials will not be permitted unless authorized in writing by Landscape Architect. If proof is submitted that any plant specified is not obtainable, a proposal will be considered for use of the nearest equivalent size or variety with corresponding adjustment of Contract Price. Such proof shall be substantiated and submitted in writing to Landscape Architect at least thirty (30) days prior to start of Work under this Section. These provisions shall not relieve Contractor of the responsibility of

obtaining specified materials in advance if special growing conditions or other arrangements must be made in order to supply specified materials.

E. Inspections: Make written request for inspection after planting operations have been completed. Such inspection is for the purpose of establishing the Maintenance Period.

F. Submit written requests for inspections to the Landscape Architect at least seven (7) days prior to anticipated inspection date.

G. Preinstallation Conference: Generally on site

1.6 DELIVERY, STORAGE, AND HANDLING

A. Submit plan for transporting plant material to site to Landscape Architect for approval. Plan should include:
   1. Date of pick-up at nursery or place of storage.
   2. Type of vehicle used for shipping.
   3. Method of protecting trees during transit.
   4. Dates in transit.
   5. Date of delivery to site.
   6. Projected date of installation.
   7. Means of storage, watering and shading used between delivery and planting.

B. Landscape Architect suggests the following considerations for the Contractor to evaluate in product handling:
   1. During hot weather and when practical, the Contractor may be required to transport plant materials between sunset and sunrise if transported in an open trailer or unrefrigerated box.
   2. Dug material should be maintained and watered as required at the nursery to guarantee their vitality and health until shipping.
   3. Protect all trunks, stems, branches and root balls during tree tying, wrapping and loading operations from damage.
   4. Load balls or containers onto transport vehicle and secure in a manner that protects the structural integrity of the root balls.
   5. The Contractor shall be solely responsible for the safe transportation of plants to the site and their condition upon arrival. Trees damaged, dehydrated or abused during transit and storage will be rejected.
   6. Plant materials should not be stored on concrete or left exposed to the sun.
   7. Protect the balls and water regularly until planting. If trees are left in storage over the weekend or holiday, provide a means of periodical watering and inspecting root ball protection.

C. Landscape Architect may inspect any phase of this operation and may reject any plant material improperly handled during any phase of this operation.

D. Nothing in this Section shall be interpreted as relieving the Contractor of the responsibility of providing healthy, viable plants, nor shall it have any affect upon the terms of the warranty specified herein.

E. Do not prune trees and shrubs before delivery. Protect bark, branches, and root systems from sun scald, drying, 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 exterior plants during delivery. Do not drop exterior plants during delivery and handling.

F. Handle planting stock by root ball.

G. Deliver exterior plants after preparations for planting have been completed and install immediately. If planting is delayed more than six hours after delivery, set exterior plants and trees in shade, protect from weather and mechanical damage, and keep roots moist.

1.7 FINAL ACCEPTANCE

A. Work under this Section will be accepted by Landscape Architect upon satisfactory completion of all work including maintenance, but exclusive of replacement of plant materials under the warranty period. Upon Final Acceptance, Owner will assume responsibility for maintenance of Work.

1.8 WARRANTY

A. Special Warranty: Installer's standard form in which Installer agrees to repair or replace plantings 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 lack of adequate maintenance, neglect, abuse by Owner, or incidents that are beyond Contractor's control.
   b. Structural failures including plantings falling or blowing over.

2. Warranty Periods from Date of Substantial Completion:

   a. Trees and Shrubs: One year.
   b. Ground Cover and Plants: Three months.

1.9 MAINTENANCE SERVICE

A. Initial Maintenance Service: Provide full maintenance by skilled employees of landscape Installer. Maintain as required in Part 3. Begin maintenance immediately after each area is planted and continue until plantings are acceptably healthy and well established, but for not less than maintenance period below.

1. Maintenance Period for Trees and Shrubs: 12 months from date of Substantial Completion.
2. Maintenance Period for Ground Covers and Plants: Three months from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 TREES, SHRUBS, VINES, AND GROUNDCOVER

A. Plants shall be nursery grown in accordance with good horticultural practices under climatic conditions similar to those of project for at least two years unless specifically otherwise authorized by Landscape Architect in writing. Unless specifically noted otherwise, all plants shall be exceptionally heavy, symmetrical, tightly knit, so trained or favored in development and appearance as to be superior in form, number of branches, compactness and symmetry.

B. Plants shall be sound, healthy and vigorous, well branched and densely foliated when in leaf. They shall be free of disease, insect pests, eggs, or larvae, and shall have healthy, well developed root systems. They shall be free from physical damage or adverse conditions that would prevent thriving growth.

C. Plants shall be true to species and variety and shall conform to measurements specified except that plants larger than specified may be used if approved by Landscape Architect. Use of such plants shall not increase Contract price. If larger plants are approved, the ball of earth or container size shall be increased as specified under "Applicable Standards" and subject to the approval of the Landscape Architect.

D. Plants shall be measured when branches are in their normal position. Height and spread dimensions specified refer to main body of plant and not branch tip to tip.

E. Container stock, when specified, shall have grown in the containers in which delivered for at least six (6) months, but not over two (2) years. Samples must prove no root-bound conditions exist. No container plants that have cracked or broken balls of earth, when taken from container, shall be planted except upon special approval by Landscape Architect. Container stock shall not be pruned before delivery. Field grown plants recently transplanted into containers will not be accepted.

F. Nursery grown B&B material (when allowable) shall be pruned and thinned at the place of growth immediately prior to digging as required for packaging and safe moving. Method of pruning shall be as approved in the field by the Landscape Architect. Do not remove self-locking tags during this pruning prior to delivery to site.

2.2 COMMERCIAL FERTILIZERS

A. Shrub/Groundcover Fertilizers: Agri-Form 20-10-5, 21 gram tablets.

B. Tree planting fertilizer: Davey Arbor Green Organic Liquid Soil injected at 115 PSI. Apply at mfg. recommended rates.

C. Top-dress Fertilizer: Complete fertilizer, 50 percent of the nitrogen to be derived from organic sources or urea-form. Available phosphoric acid shall be from superphosphate, bone or tankage. Potash shall be derived from potassium sulfate containing 60 percent potash.

2.3 PRE-EMERGENCE WEED CONTROL

A. In areas of Woody Ornamental Plants, Eptam or Eptam -5-G as manufactured by Greenlight Products Company, or approved equal.

2.4 STAKING MATERIALS

A. Use staking materials necessary to meet requirements of specifications, subject to approval. Suggested materials:
   1. Tree Stakes: Green, Eight (8') feet long steel T-Post weighing 1.33 pounds per foot.
   2. Ties: Black rubber 3/4-inch hose with 3/16-inch wall thickness
   3. Tree Guying Material: #10 gage galvanized multi-strand cable.
   4. Cable Clamps: Size needed to hold two strands together.

2.5 MULCH

A. Shredded Hardwood bark.

2.6 INSECTICIDE

A. Ortho "Lindane Borer and Leaf Miner Spray" by Ortho, Consumer Products Division, Chevron Chemical Company, San Francisco, California 94119, or "Borer Killer" by Greenlight Company, San Antonio, Texas 78217.

2.7 WATERING TUBES

A. Gray, perforated SDR PVC drainage pipe, 4 inches in diameter.

PART 3 - <u>EXECUTION</u>

3.1 LAYOUT AND EXCAVATION OF PLANTING AREAS:

A. Layout plants in locations shown on Drawings. Use wire stakes color-coded for each specie of plant material. Stake location of each tree and major shrub and outline of shrub and groundcover beds.

B. Landscape Architect will check location of plants in the field and shall adjust to exact position before planting begins.

C. Subsoil shall not be worked when moisture content is so great that excessive compaction should occur, nor when it is so dry that clods will not break readily. Water shall be applied, if necessary, to bring soil to an optimum moisture content for tilling and planting.

D. Excavate entire planting beds to a depth of 8 inches.

3.2 DRAINAGE, DETRIMENTAL SOILS, AND OBSTRUCTIONS:

A. Test drainage of plant beds and pits by filling with water twice in succession. Conditions permitting the retention of water in planting beds for more than twenty four (24) hours or percolation of less than one inch per hour shall be brought to the attention of the Owner.

B. Notify the Landscape Architect in writing of all soil or drainage conditions Contractor considers detrimental to growth of plant material.

C. If rock, hardpan, underground construction work, tree roots or other obstructions are encountered in the excavation of plant pits and beds, alternate locations may be selected by Landscape Architect. Where locations cannot be changed, submit cost required to remove the obstructions to a depth of not less than 6 inches below the required pit or bed depth. Proceed with work after approval.

3.3 PREPARING PLANT MATERIALS FOR PLANTING:

A. Canned stock shall be removed carefully after cans have been cut on two sides with approved cutter. Do not use spade to cut cans. Do not lift or handle container plants by tops, Stems, or trunks at any time.

B. Do not bind or handle any plant with wire or rope at any time so as to damage bark or break branches. Lift and handle plants only from bottom of ball.

3.4 INSTALLATION OF BED PLANTED MATERIALS:

A. Fill all shrub and groundcover beds with plant bed mix to finished grade (compacted).

B. Excavate in planting mix for individual plant and install as required. Set plant plumb and brace rigidly in position until planting soil mix has been tamped solidly around the ball and roots.

C. When plant pits have been backfilled approximately two-thirds (2/3) full, place Agriform tablets evenly distributed in plant pits according to the following schedule:

1 gallon equivalent - 1 tablet
5 gallon equivalent - 2 tablets

D. Water thoroughly, saturating root ball, before installing remainder of the planting soil to top of pit, eliminating all air pockets. Top of root ball shall be 2 inches above finished grade.

E. Smooth planting areas to conform to specified grades after full settlement has occurred. Contractor shall bear final responsibility for proper surface drainage of planted areas.

F. Water all plants immediately again after planting.

G. Apply pre-emergent weed control material over entire area to receive mulch.

H. Mulch all shrub and groundcover beds as detailed on Drawings.

3.5 SURFACE DRAINAGE OF PLANTING AREAS

A. Contractor shall bear final responsibility for proper surface drainage of planted areas. Any discrepancy in the Drawings or Specifications, obstructions on the site, or prior work done by another party which Contractor feels precludes establishing proper drainage, shall be brought to the attention of Landscape Architect in writing for correction or relief of said responsibility.

3.6 PRUNING

A. Prune containerized plants only at time of planting and according to standard horticultural practice to preserve the natural character of the plant. Prune by removing entangled branching and by removing crotches. Avoid removing branch tips wherever possible. Pruning to be done under supervision of the Landscape Architect.

B. Remove all dead wood, suckers, and broken or badly bruised branches. Use only clean, sharp tools.

C. Paint cuts over 3/4- inch diameter with tree paint, covering all exposed, living tissue.

3.7 STAKING

A. Contractor shall stake trees and shall be responsible for material remaining plumb and straight for all given conditions through the guarantee period. Tree support shall be done as outlined on the following tables.

B. Staking shall be completed immediately after planting. Plants shall stand plumb after staking.

C. Stake all trees in accordance with the following table:

Tree	No. of Stakes	Stake Size
30 Gal. and B&B	2	7 ft. T-Post
65 Gal. to 100 Gal.	3	8 ft. T-Post

D. Machine moved trees do not require staking or guying.

E. Locate first stake on prevailing windward side of tree and as close to the main trunk as is practical, avoiding root injury. Stakes shall be driven at least 18 inches into firm ground.

F. Tie tree to stake using approved tree tie. Tie shall be located midway within tree crown or at a location approximately two-thirds (2/3) of the overall height of the tree. Locate tie just above major side branch in order to deter slippage of tie.

G. Locate second stake opposite first. Secure with one tie opposite upper tie at first stake.

H. Where used, stakes shall be equally spaced around the tree and placed equal distances from the trunk.

I. Auxiliary stem stakes shipped with trees shall be removed after shipping.

3.8 CLEANING

A. Clean all areas as required for complete and acceptable inspection.

3.9 INSPECTIONS:

A. Make written request for inspection after planting operations are completed.

B. Submit requests for inspections to the Owner at least two (2) days prior to anticipated inspection date.

3.10 PLANT MAINTENANCE

A. Tree and Shrub Maintenance: Maintain plantings by pruning, cultivating, watering, weeding, fertilizing, restoring planting saucers, and resetting to proper grades or vertical position, as required to establish healthy, viable plantings. Spray or treat as required to keep trees and shrubs free of insects and disease.

B. Ground Cover and Plant Maintenance: Maintain and establish plantings by watering, weeding, fertilizing, mulching, and other operations as required to establish healthy, viable plantings.

C. Protect exterior plants from damage due to landscape operations, operations by other contractors and trades, and others. Maintain protection during installation and maintenance periods. Treat, repair, or replace damaged plantings.

END OF SECTION 329313

SECTION 33 11 00 - WATER UTILITY DISTRIBUTION PIPING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Buried pipe and fitting.

B. Valves.

C. Fire hydrants.

D. Thrust blocks and harnessing.

E. Field quality control.

F. Test.

G. System disinfection.

H. Connections to existing mains.

1.2 RELATED SECTIONS

A. Trenching, bedding, and backfilling for pipelines are specified in Section 33 05 28 - Trenching and Backfilling for Utilities.

B. Coordinate the work of this Section with the work of Section 22 11 01 - Water Distribution

1.3 MEASUREMENT AND PAYMENT

A. General: Measurement and payment for the water distribution system will be either by the lump-sum method or by the unit-price method as determined by the listing of the bid item for the water distribution system indicated in the Bid Schedule of the Bid Form.

B. Lump sum: If the Bid Schedule indicates a lump sum for the water distribution system, the lump-sum method of measurement and payment will be in accordance with Section 01 20 00 Price and Payment Procedures, Article 1.03.

C. Unit price: If the Bid Schedule indicates a unit price for the water distribution system, the unit-price method of measurement and payment will be as follows:

1. Measurement:

a. Water distribution system will be measured for payment by the linear foot of pipe, installed in place, tested and disinfected, for each type and size of pipe, along the centerline of the pipe with deductions made for manholes or other structures, measured from the inside face of each structure.

b. Utility structures will be measured separately for payment as specified in Section 33 05 16, Utility Structures.

c. Pipe fittings, valves, joints, pipe bedding, collar taps, and cutting of pipe will not be measured separately for payment, and all costs in connection therewith will be considered as included in the linear foot measurement for pipe.

d. Fire hydrants will be measured for payment by the individual unit (each), installed in place and acceptably tested.

e. Support of trench excavation, maintenance, support of existing utility facilities, grading, excavation and backfill, cast-in-place concrete, and incidental work pertaining to the installation of pipe will not be measured separately for payment, but will be considered as included in the linear foot measurement for pipe.

2. Payment: The water distribution system will be paid for at the indicated Contract unit prices for the computed quantities as determined by the measurement method specified in Article 1.03.C.1.

1.4 REFERENCES

A. American Society for Testing and Materials (ASTM):

1.	ASTM A126	Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings
2.	ASTM A197	Specification for Cupola Malleable Iron
3.	ASTM A307	Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile
4.	ASTM D1784	Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds
5.	ASTM D1785	Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120
6.	ASTM D2466	Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40
7.	ASTM D2564	Specification for Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Pipe and Fittings
8.	ASTM D2855	Practice for Making Solvent-Cemented Joints, with Poly (Vinyl Chloride) (PVC) Pipe and Fittings
9.	ASTM D3139	Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals
10.	ASTM F439	Specification for Socket-Type Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80
11.	ASTM F477	Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe

B. American Water Works Association (AWWA):

1. AWWA C500 — Gate Valve, 3 through 48 inches NPS – for Water and Sewage System
2. AWWA C503 — Standard for Wet-Barrel Fire Hydrants
3. AWWA C504 — Rubber Seated Butterfly Valve
4. AWWA C508 — Swing-Check Valves for Water Works Service, 2 inches through 24 inches NPS
5. AWWA C606 — Grooved and Shouldered Type Joints
6. ANSI/AWWA C651 — Standard for Disinfecting Water Mains
7. ANSI/AWWA C900 — Specification for Polyvinyl Chloride (PVC) Pressure Pipe, 4 in. through 12 in. for Water Distribution

C. Water Utility District Standards: Note that all work shall be performed and completed in accordance with the jurisdictional water utility district's standard drawings and specifications. The Contractor shall be responsible for obtaining all such standards and for compliance with such standards as applicable.

D. Underwriters Laboratories Inc. (UL):

1. UL 246 — Hydrant for Fire-Protection Service

1.5 SUBMITTALS

A. Refer to Section 01 33 00 - Submittal Procedures, and Section 01 33 23 - Shop Drawings, Product Data, and Samples, for submittal requirements and procedures.

B. Submit respective manufacturer's product data for manufactured materials and equipment, including all valves and fire hydrants.

C. Submit Shop Drawings showing piping layout and pipe, valves, hydrants, and locations of tie- ins, buttresses, and thrust blocks.

1.6 SUBMITTALS FOR CLOSEOUT

A. General: Refer to Section 01 77 00 - Closeout Procedures, and Section 01 78 23 - Operation and Maintenance Data, for submittal requirements and procedures.

B. Record Drawings: Record actual location of piping mains, valves, connections, and invert elevations for review.

1.7 SITE CONDITIONS

A. Excavations in which products will be buried shall be dry.

B. Coordinate the installation of the water supply system with the jurisdictional water utility owner.

C. The jurisdictional water utility district shall provide water services to the water meters' points of connection for station facilities and landscape irrigation systems, and modifications to existing water mains, as indicated on the Contract Drawings. The Contractor shall be responsible for making all such arrangements.

PART 2 - PRODUCTS

2.1 BURIED PIPE AND FITTINGS

A. Requirements: Provide the types, sizes, and configurations of pipe, fittings, and miscellaneous materials and installation accessories as indicated.

B. PVC Pipe and Fittings, 3 Inches and Smaller:

1. Pipe: Polyvinyl chloride (PVC), ASTM D1785, Schedule 40 or 80, as indicated, Type I, Grade 1.

2. Fittings: ASTM D2466, socket weld, same material and schedule as pipe, or meeting requirements of ASTM F439, as applicable.

3. Joints: Socket welded with PVC solvent cement conforming to ASTM D2564 and ASTM D2855.

C. PVC Pipe and Fittings, 4 Inches and Larger:

1. Pipe: AWWA C900, Class 200, polyvinyl chloride (PVC) water pipe with bell and spigot ends and flexible ring joints.

2. Fittings: ASTM D1784, Type 1, Grade 1, polyvinyl chloride (PVC) fittings, Class 200, or meeting requirements of ASTM F439, as applicable.

3. Joints: ASTM D3139, gasketed bell joints with ASTM F477 gaskets.

2.2 VALVES

A. Gate Valves:

1. Gate Valves up to 2-1/2 Inches: 150 pound bronze body, non-rising stem, single wedge, threaded connection.

2. Gate Valve 3 Inches and Over: AWWA C500, iron body, bronze trim, non-rising stem with square nut, single wedge, mechanical joint ends with type gland and serration's designed for plastic pipe service.

B. Pressure Reducing Valves: All bronze construction, spring-loaded, single-seated, suitable for tight shutoff under dead-end conditions. Provide with renewable composition seat discs, nylon inserted diaphragm, bolted spring chamber, and threaded connection.

C. Backflow Preventer: Provide a device that is approved by the jurisdictional water utility company. As a minimum, the backflow preventer shall be a reduced pressure principle assembly with two rising-stem gate shut-off valves, two resilient seat ball-valve test cocks, two check valves replaceable resilient disks and seat with relief valve with replaceable seat. Backflow preventer shall be suitable for 175 psig operating pressure and 140 degrees F operating temperature, and shall be of bronze construction with bronze internal parts and stainless steel springs, screwed inlet and outlet for 2-inch and smaller sizes, and cast iron, epoxy- coated construction with 150 pound flanged inlet and outlet for 3-inch and larger sizes.

2.3 FIRE HYDRANTS

A. Provide fire hydrants and related appurtenances as indicated. Fire hydrants shall comply with the requirements of the jurisdictional authority and the standard drawings and specifications of the jurisdictional water utility district, as applicable.

B. Fire hydrants shall meet the requirements of AWWA C502 and UL 246, as applicable, and shall be wet barrel type, as a minimum, with a minimum of two discharge nozzles of size(s) required by the jurisdictional authority.

2.4 CONCRETE FOR THRUST BLOCKS

A. Provide Class 3000, 1-inch aggregate, concrete for all thrust blocks, as specified in Section 03 05 15 - Portland Cement Concrete, with reinforcement where indicated.

2.5 MISCELLANEOUS METAL

A. Tie Rods: Stainless steel, Type 316, threaded ANSI standard, bolt threaded on both ends. Minimum 1/2-inch diameter for 4-inch pipe, 5/8-inch minimum diameter for 6-inch and 8-inch diameter pipe, and 3/4-inch minimum diameter for 12-inch and larger.

B. Rod Couplings: Malleable iron, ASTM A197, turnbuckle design, female threaded to mate with tie rods, 5/8-inch and 3/4-inch sizes to mate with both rods and mechanical joint bolts.

C. Pipe Clamps: For sizes 4 inches and larger, provide with malleable iron rod sockets. Provide washers in lieu of rod sockets where authorized, conforming with ASTM A126, Class A, cast iron. Bolts and bolting shall conform with ASTM A307.

PART 3 - EXECUTION

3.1 MAINTAINING WATER SERVICES

A. Maintain water service and conduct operations at times selected to minimize the duration and inconvenience of service interruption.

B. At least 24 hours prior to the required cutting or abandoning of an existing water main, notify the jurisdictional water utility owner, and obtain approval of the schedule. Actual cutting or abandoning of an existing water main shall be performed by the Contractor after receiving approval from the owner of the facility.

C. Keep existing water mains parallel to new water mains in service until new water mains are ready for service.

D. Where the existing water main or service is to be cut for connection to new piping, the work shall be performed by the Contractor. Initial work operations shall include the test-pitting of all points of connection (tie-in) to ensure the true location of existing linework.

E. Water valves in service shall be operated only by personnel of the jurisdictional water utility owner.

F. Except as specified otherwise herein, construction methods shall be in accordance with the applicable provisions of the jurisdictional water utility owner's standard drawings and specifications.

3.2 INSTALLATION

A. Installation Requirements:

1. Excavate pipe trench in accordance with Section 33 05 28 - Trenching and Backfilling for Utilities. Hand trim bottom of trench to approximately 6 inches below invert of pipe.

2. Top of pipe to finished grade shall be 30 inches unless otherwise indicated or approved by the Engineer.

3. Place sand bedding material, meeting the requirements of Section 33 05 28 - Trenching and Backfilling for Utilities, at trench bottom, level in one continuous layer not exceeding 8 inches in compacted depth. Compact bedding to 95 percent relative density.

4. Backfill around sides and to 6 inches above pipe with cover fill tamped in place and compacted to 95 percent relative density.

5. Test pipe distribution system and place tracer wire on top of pipe as specified herein prior to covering pipe. Backfill trench in accordance with Section 33 05 28 - Trenching and Backfilling for Utilities.

6. Maintain optimum moisture content of bedding material to attain required compaction density.

7. Provide concrete thrust blocks for elbows, tees, valves, and appurtenances of buried piping. Thrust blocks shall be constructed as indicated and in accordance with AWWA requirements.

8. Install piping true to line and grade, supported and guided to assure alignment under all conditions.

9. Install pipe to allow for expansion and contraction without stressing pipe or joints.

10. Install unions at each connection to valves, both sides of each valve.

11. Make change in line with fittings. Do not spring joints to effect change of direction.

12. Do not field cut pipe unless necessary. Make such necessary cuts by means of equipment designed for the purpose, ensuring a smooth and square end.

13. For connection to existing pipe, provide pipe with suitable ends or adapters, after verification of size and type of existing pipe.

14. Install tie rods and pipe clamps at every joint fitting and valve.

B. Valves:

1. Install valves in accordance with the valve manufacturer's installation instructions.

2. Where valves are provided by the jurisdictional water utility owner, provide suitable access for performance of such work.

3. Where necessary, alter the typical valve manhole to suit actual conditions. Any alterations in valve manholes shall be operable from the street level. All operator nuts shall be plumb to the valve manholes.

4. Set valve on solid bearing.

5. Center and plumb valve box over valve. Set box cover flush with finished grade.

C. Fire Hydrants:

1. Provide fire hydrant installations as indicated. Installation shall conform with requirements of the jurisdictional fire department and the water utility owner's standard drawings and specifications.

2. Provide necessary appurtenances and accessories as required to complete the installation.

3. Paint hydrants in accordance with applicable requirements of Section 09 91 00, Painting.

4. Set hydrants plumb, locate pumper nozzle perpendicular to and facing roadway.

D. Thrust Blocks and Harnessing:

1. Provide for counteracting thrust caused by static and dynamic forces, including water hammer at bends, tees, reducers, valves, and dead-ends by installing harnessing as indicated or required. For other methods, submit details for approval of the jurisdictional water utility owner prior to use.

2. Provide concrete thrust blocks as indicated where harnessing is not practicable.

E. Water Service Connections: Provide water service connections, where necessary, in accordance with the California Plumbing Code, the installation instructions of the service pipe and fittings manufacturer, and the utility company requirements with reduced pressure back-flow preventer and water meter with by-pass valves.

F. Acceptance Requirements: After installation of pipes, ends of pipes shall be either capped or plugged. No piping shall be buried before being inspected and tested.

3.3 FIELD QUALITY CONTROL

A. Refer to Section 01 43 00 - Quality Assurance, for requirements.

B. Compaction testing of related earthwork shall be performed in accordance with applicable requirements of Section 31 00 00 - Earthwork.

C. If tests indicate work does not meet specified requirements, remove such work, replace, and retest at no additional cost to the District.

3.4 TESTS

A. Protection from Flooding: Provide positive measures to protect exposed, installed pipe and compacted pipe bedding from flooding during testing.

B. Notice of Testing:

1. Give 48 hours notice of intention of testing to the jurisdictional water utility owner, which will furnish, install, and operate pumps, gages, meters, and individual pipe connections to test openings.

2. Designate largest sections feasible for testing and sterilizing. Testing and sterilizing operations shall be performed by the Contractor; at Contractor's expense.

C. Testing Requirements:

1. General:

a. Prior to backfilling, isolate the system by use of approved valves, caps and plugs, or other acceptable methods.

b. Maintain such isolation throughout the performance of leakage and pressure testing.

c. Where valves are used for isolation, eliminate leakage through such valves if it occurs. Maintain new work isolated from existing water mains, except for test connections, until testing and sterilization have been completed.

2. Hydrostatic Tests:

a. For hydrostatic tests, provide approved caps and plugs in sections to be tested, and remove them after testing.

b. Prevent leakage in pipes and fittings at openings. Temporarily block plugged and capped ends to prevent displacement.

c. Install the water source connection for testing the isolated section. The Engineer may permit the use of a tap that will be furnished and installed by utility owner.

d. Provide labor and materials required for leakage testing, including excavation for installation and removal of pumps, gages, meters, and water source connections.

e. Where leakage exceeds the water utility company's standards, perform necessary corrective measures.

f. Remove and replace defective pipes, joints, fittings, valves, and other appurtenances. Reset such items if displaced.

g. Perform hydrostatic tests in accordance with the jurisdictional water utility district's requirements. All such tests shall be witnessed by the jurisdictional water utility district's representative. The Contractor shall be responsible for making all such arrangements.

h. Remove and replace defective pipe, joints, fittings, valves, and other appurtenances. Reset such items if displaced.

D. Testing and Flushing of Potable Water System: Test the potable water system hydrostatically in sections to a pressure of at least 150 psi for not less than 15 minutes, witnessed by the Engineer. Pressure test pipe before burial. Repair leaks and retest the system until the system is leak free. Use testing instruments calibrated by a qualified laboratory in accordance with Section 01 45 00 - Quality Control. Test sequence shall be as follows:

1. Lines shall be fully flushed.

2. Lines shall be hydrostatically tested.

3. Lines shall be fully flushed.

4. Lines shall be fully disinfected.

3.5 SYSTEM DISINFECTION

A. Before final acceptance of the water supply system, each section of the new line shall be disinfected in accordance with ANSI/AWWA C651. One of the following sources of disinfectant shall be used:

1. Mixture of water and chlorine gas;

2. Direct application of chlorine;

3. Mixture of water and calcium hypochlorite; or

4. Mixture of water and calcium chloride.

B. Before disinfecting, flush the line thoroughly to remove dirt and extraneous materials. Clean each section of the line between valves independently.

C. Retain the disinfectant solution in the pipe for at least 24 hours. Following this sterilization period, the residual chlorine content at the ends of the section and at other representative points shall be not less than five parts per million. Then, the line shall be drained and thoroughly flushed with water until the residual chlorine content is similar to that obtained from the existing water distribution system.

D. Take water samples and test in accordance with ANSI/AWWA C651.

3.6 CONNECTIONS TO EXISTING MAINS

A. Following testing and sterilization, new water distribution lines shall be connected to existing mains as indicated. Each connection shall be made at a time and in a manner that will result in the least interruption of service.

B. All connections involving shut down of jurisdictional water utility's existing facilities shall be made under the immediate supervision of the jurisdictional water utility district. No member of the Contractor's forces may operate any valve controlling the flow of water in the water utility's existing system.

C. The Contractor shall provide tie-ins to the existing system at a time that is convenient to jurisdictional water utility district, which may be in the evenings and on weekends.

END OF SECTION 33 11 00

SECTION 33 21 00 - WATER SUPPLY WELLS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:

1. **Rotary drilled** water supply wells.
2. **Submersible** well pumps.

1.3 DEFINITIONS

A. PE: Polyethylene plastic.

B. PVC: Polyvinyl chloride plastic.

1.4 PERFORMANCE REQUIREMENTS

A. Minimum Tested Water Supply Well Performance Capacity: 120 gallons per minute

1.5 ALLOWANCES

A. Allowance amounts and quantities are specified in Section 012100 "Allowances."

1. Water Supply Well Depth Allowance: Install complete and functional well to depth indicated on Drawings. If water supply well depths vary from quantities on drawings, the Contract Sum will be adjusted according to unit prices listed in "Unit Prices" Article. Include the following in the Contract Amount:
2. Labor for water supply well installation.
3. Furnishing and installing casing materials, grout, well screen, and packing materials in required diameter to comply with minimum performance requirements specified above.
4. Furnishing and installing well pump.
5. Run water supply lines to each building as shown on drawings

B. Water supply well and well pump shall be fully priced as shown on drawings

1.6 UNIT PRICES

A. Unit-Price Amounts: Show unit price per foot for additional well depth beyond 150’ in depth.

B. Measurement and Payment Procedures: Specified in Section 012200 "Unit Prices."

C. Measurement Units for Water Supply Wells, Casings, and Grout: Per linear foot of well depth.

1.7 ACTION SUBMITTALS

A. Product Data: Submit certified performance curves and rated capacities of selected well pump and furnished specialties and accessories for each type and size of well pump indicated on drawings.

B. Shop Drawings: Show layout and connections for well pumps.

1. Copy of Texas well drilling and pump installers license

2. Wiring Diagrams: Power, signal, and control wiring.
3. Setting Drawings: Include templates and directions for installing foundation bolts, anchor bolts, and other anchorages.
4. Project Record Documents: Record the following data for water supply well:

    a. Casings: Material, diameter, thickness, weight per foot of length, and depth below grade.
    b. Screen: Material, construction, diameter, and opening size.
    c. Pumping Test: Static water level, maximum safe yield, and drawdown at maximum yield.
    d. Log: Formation log indicating strata encountered.
    e. Alignment: Certification that well is aligned and plumb within specified tolerances.

5. Provide submittal on VFD matched with submersible pump.

1.8 INFORMATIONAL SUBMITTALS

A. Field quality-control reports, including the following:

1. Substrata formations. Well log to be filed with State of Texas
2. Water-bearing formations.
3. Water levels.
4. Laboratory water analysis.
5. Well-screen analysis.
6. Performance test data.

1.9 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For well pump to include in emergency, operation, and maintenance manuals.

1.10 QUALITY ASSURANCE

A. Well Driller Qualifications: An experienced water supply well driller licensed in the jurisdiction where Project is located.

B. 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.

C. 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.

D. Comply with AWWA A100 for water supply wells.

1.11 PROJECT CONDITIONS

A. Interruption of Existing Water Service: Do not interrupt water service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary water service according to requirements indicated:

1. Notify Engineer no fewer than seven days in advance of proposed interruption of water service.
2. Do not proceed with interruption of water service without Owner's written permission.

B. Well Drilling Water: **Owner will provide** temporary water for drilling purposes. Contractor to provide necessary piping for water supply to buildings.

1.12 WARRANTY

A. Warranty on all products will be free of defects in workmanship for a period of three (3) years from date of installation.

PART 2 - PRODUCTS

2.1 WELL CASINGS

A. PVC Casing: ASTM F 480, PVC, Schedule 80 bell-and-spigot pipe and couplings for solvent-cemented joints. Include NSF listing mark "NSF w.c."

B. Pit-less Adapter: Fitting, of shape required to fit onto casing, with waterproof seals.

C. Pit-less Unit: Factory-assembled equipment that includes pit-less adapter.

D. Well Seals: Casing cap, with holes for piping and cables, that fits into top of casing and is removable, waterproof, and vermin proof.

2.2 GROUT

A. Cement: ASTM C 150, Type V.

B. Aggregates: ASTM C 33, fine and coarse grades.

C. Water: Potable.

2.3 WATER WELL SCREENS

A. Screen Material: Fabricated of ASTM A 666, slotted PVC; with continuous-slot, V-shaped openings that widen inwardly and designed for well-screen applications.

1. Screen Couplings: Butt-type, PVC coupling rings.
2. Screen Fittings: Screen, with necessary fittings, closes bottom and makes tight seal between top of screen and well casing.
3. Maximum Entering Velocity: 0.1 fps.

2.4 PACK MATERIALS

A. Coarse, uniformly graded filter sand, maximum 1/8 inch in diameter.

B. Fine gravel, maximum 1/4 inch in diameter.

2.5 SUBMERSIBLE WELL PUMPS

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

1. Grundfos Pumps Corporation.
2. Franklin Electric Pumps.
3. Goulds Pumps

B. Description: Submersible, vertical well pump complying with HI 2.1-2.2 and HI 2.3; with the following features:

1. Impeller Material: Stainless steel.
2. Motor: Capable of continuous operation under water, with protected submersible power cable.
3. Column Pipe: ASTM A 53/A 53M, Schedule 80, PVC pipe with threaded ends and threaded couplings.
4. Discharge Piping: ASTM D 2239, SIDR Numbers 9 PE pipe; made with PE compound number required to give pressure rating not less than 160 psig. Include NSF listing mark "NSF pw."

C. Capacities and Characteristics:

1. Capacity: 120 GPM
2. Discharge Head: 60 psig
3. Discharge Size: 1-1/2”
4. Speed: 3450
5. Motor Horsepower: 5 HP
6. Lift: 90 ft
7. Pressure Rating: 150
8. Volts: 460
9. Phases: 3
10. Hertz: 60

2.6 MOTORS

A. General requirements for motors are specified in Section 220513 "Common Motor Requirements for Plumbing 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: Electrical devices and connections are specified in electrical Sections. Pump shall be variable flow with VFD controller

PART 3 - EXECUTION

3.1 PREPARATION

A. Neighborhood Well Data: Review operating and test analyses and address any concerns with Engineer.

3.2 INSTALLATION

A. Construct well using rotary drilling method.

B. Take samples of substrata formation at 10-foot intervals and at changes in formation throughout entire depth of each water supply well. Carefully preserve samples on-site in glass jars properly labeled for identification.

C. Excavate for mud pit or provide aboveground structure, acceptable to authorities having jurisdiction, to allow settlement of cuttings and circulation of drill fluids back to well without discharging to on-site waterways.

D. Set casing and liners round, plumb, and true to line.

E. Join casing pipe as follows:

1. Ream ends of pipe and remove burrs.
2. Remove scale, dirt, and debris from inside and outside casing before installation.
3. Cut bevel in ends of casing pipe and make joints.
4. Clean and make solvent-cemented joints.

F. Mix grout in proportions of 1 cu. ft. or a 94-lb sack of cement with 5 to 6 gal. of water. Bentonite clay may be added in amounts of 3 to 5 lb/cu. ft. for a 94-lb sack of cement. If bentonite clay is added, water may be increased to 6.5 gal./cu. ft. of cement.

G. Place grout continuously, from 50’ to top surface, to ensure filling of annular space in one operation. Do not perform other operations in well within 72 hours after grouting of casing.

H. Provide permanent casing with temporary well cap. Install with top of casing 36 inches above finished grade.

I. Develop well to maximum yield per foot of drawdown.

1. Extract maximum practical quantity of sand, drill fluid, and other fine materials from water-bearing formation.

2. Avoid settlement and disturbance of strata above water-bearing formation.
3. Do not disturb sealing around well casings.
4. Continue developing well until water contains no more than 2 ppm of sand by weight when pumped at maximum testing rate.

J. Install **submersible** well pumps according to HI 2.1-2.4 and provide access for periodic maintenance.

1. Before lowering permanent pump into well, lower a dummy pump that is slightly longer and wider than permanent pump to determine that permanent pump can be installed. Correct alignment problems.
2. Before lowering permanent pump into well, start pump to verify correct rotation.
3. Securely tighten discharge piping joints.
4. Connect motor to submersible pump and locate near well bottom.

a. Connect power cable while connection points are dry and undamaged.
b. Do not damage power cable during installation; use cable clamps that do not have sharp edges.
c. Install pit-less adapter that will support pump and piping.

3.3 CONNECTIONS

A. Piping installation requirements are specified in "Facility Water Distribution Piping." Drawings indicate general arrangement of piping, fittings, and specialties.

1. Connect piping between well pump and water piping.
2. Connect water distribution system in trench to well pipe at pit-less **adapter**.
3. Connect building water distribution to well.

B. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."

C. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.4 WELL ABANDONMENT

A. Comply with AWWA A100 when abandoning water supply wells. Fill and seal holes and casings and restore ground surface to finished grade.

B. Follow well-abandonment procedures of authorities having jurisdiction. Restore ground surface to finished grade.

C. Contact Engineer immediately if this condition applies.

3.5 FIELD QUALITY CONTROL

A. Test Preparation: Clean water supply wells of foreign substances. Swab casings using alkalis, if necessary, to remove foreign substances.

B. Perform tests and inspections and prepare test reports.

C. Tests and Inspections:

1. Plumbness and Alignment Testing: Comply with AWWA A100.
2. Furnish samples of water-bearing formation to testing laboratory and well-screen manufacturer for mechanical sieve analysis.
3. Prepare reports on static level of ground water, level of water for various pumping rates, and depth to water-bearing strata.
4. Performance Test Preparation: Start well pump and adjust controls and pressure setting. Replace damaged and malfunctioning controls and equipment.
5. Performance Testing: Conduct final pumping tests after wells have been constructed, cleaned, and tested for plumbness and alignment.

    a. Arrange to conduct tests, with seven days' advance notice, after test pump and auxiliary equipment have been installed. Note water-level elevations referred to for each assigned datum in wells.
    b. Provide discharge piping to conduct water to locations where disposal will not create a nuisance or endanger adjacent property. Comply with requirements of authorities having jurisdiction.
    c. Provide and maintain equipment of adequate size and type for measuring flow of water, such as weir box, orifice, or water meter.
    d. Measure elevation to water level in wells.
    e. Perform two bailer or air-ejection tests to determine expected yield. Test at depths with sufficient quantity of water to satisfy desired yields.
    f. Test Pump: Variable capacity test pump with capacity equal to maximum expected yields at pressure equal to drawdown in wells, plus losses in pump columns and discharge pipes.
    g. Start and adjust test pumps and equipment to required pumping rates.
    h. Record readings of water levels in wells and pumping rates at 15-minute maximum intervals throughout 10-hour minimum period.
    i. Record maximum yields when drawdown is 48” above top of suction screens after designated times.
    j. Operate pumping units continuously for 24 hours after maximum drawdown is reached.
    k. Record returning water levels in wells and plot curves of well recovery rates.
    l. Remove sand, stones, and other foreign materials that may become deposited in wells after completing final tests.

D. Water Analysis Testing:

1. Engage a qualified testing agency to make bacteriological, physical, and chemical analyses of water from each finished well and report the results. Make analyses according to requirements of authorities having jurisdiction.
2. Analyze water sample from finished well for bacteriological, physical, and chemical quality and report the results. Make analyses according to requirements of authorities having jurisdiction.

3.6 CLEANING

A. Disinfect water supply wells according to AWWA A100 and AWWA C654 before testing well pumps.

B. Follow water supply well disinfection procedures required by authorities having jurisdiction before testing well pumps.

3.7 PROTECTION

A. Water Quality Protection: Prevent well contamination, including undesirable physical and chemical characteristics.

B. Ensure that mud pit will not leak or overflow into streams or wetlands. When well is accepted, remove mud and solids in mud pit from Project site and restore site to finished grade.

C. Provide casings, seals, sterilizing agents, and other materials to eliminate contamination; shut off contaminated water.

D. Exercise care to prevent breakdown or collapse of strata overlaying that from which water is to be drawn.

E. Protect water supply wells to prevent tampering and introducing foreign matter. Retain temporary well cap until installation is complete.

END OF SECTION 33 21 00

SECTION 33 31 00 - SANITARY UTILITY SEWERAGE PIPING

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Buried Pipe and Fittings

B. Cleanouts

C. Sewage Ejector

D. Field Quality Control

1.02 RELATED SECTIONS

A. Section 01 33 00 - Submittal Procedures

B. Section 01 33 23 - Shop Drawings, Product Data, and Samples

C. Section 01 45 00 – Quality Control

D. Section 01 77 00 – Closeout Procedures

E. Section 01 78 23 – Operation and Maintenance Data

F. Section 01 78 39 – Project Record Documents

G. Section 22 13 01 – Sanitary Sewerage

H. Section 22 14 29 – Water Distribution

I. Section 31 00 00 – Earthwork

J. Section 33 05 16 – Utility Structures

K. Section 33 05 28 – Trenching and Backfilling for Utilities

1.03 MEASUREMENT AND PAYMENT

A. General: Measurement and payment for the site sanitary sewerage system will be either by the lump-sum method or by the unit-price method as determined by the listing of the bid item for the site sanitary sewerage system indicated in the Bid Schedule of the Bid Form.

B. Lump Sum: If the Bid Schedule indicates a lump sum for the site sanitary sewerage system, the lump-sum method of measurement and payment will be in accordance with Section 01 20 00 - Price and Payment Procedures, under Article entitled “Lump-Sum Measurement”.

C. Unit Price: If the Bid Schedule indicates a unit price for the site sanitary sewerage system, the unit-price method of measurement and payment will be as follows:

1. Measurement:

a. Site sanitary sewerage system will be measured for payment by the linear foot of pipe, installed in place and tested, for each type and size, along the centerline of the pipe, with deductions made for manholes or other structures, measured from the inside face of each structure.

b. Utility structures will be measured separately for payment as specified in Section 33 05 16 - Utility Structures.

c. Pipe fittings, joints, pipe bedding, cleanouts, collar taps, and cutting of pipe will not be measured separately for payment, and all costs in connection therewith will be considered as included in the linear foot measurement for pipe.

d. Support of trench excavation, maintenance, support of existing utility facilities, excavation and backfill, concrete, and incidental work pertaining to the installation of sewer pipe will not be measured separately for payment, but will be considered as included in the linear foot measurement for sewer pipe.

2. Payment: Site sanitary sewerage system will be paid for at the indicated Contract unit prices for the computed quantities as determined by the measurement method specified in Article 1.03.C.1.

1.04 REFERENCES

A. American National Standards Institute (ANSI):

1. ANSI A21.11 Rubber Gasket Joints for Cast Iron and Ductile Iron Pressure Pipe and Fittings

B. American Society for Testing and Materials (ASTM):

1. ASTM A74 Specification for Cast Iron Soil Pipe and Fittings

2. ASTM C12 Practice for Installing Vitrified Clay Pipe Lines

3. ASTM C14 Specification for Concrete Sewer, Storm Drain, and Culvert Pipe

4. ASTM C76 Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe

5. ASTM C425 Specification for Compression Joints for Vitrified Clay Pipe and Fittings

6. ASTM C443 Specification for Joints for Circular Concrete Sewer and Culvert Pipe, using Rubber Gaskets

7. ASTM C564 Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings

8. ASTM C700 Specification for Vitrified Clay Pipe, Extra Strength, Standard Strength and Perforated

9. ASTM D1785 Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120

10. ASTM C2321 Practice for Underground Installation of Flexible Thermoplastic Sewer Pipe

11. ASTM D2466 Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe and Fittings, Schedule 40
12. ASTM D2564 Specification for Solvent Cements for Poly (Vinyl Chloride (PVC) plastic Pipe and Fittings

13. ASTM D2565 Specification for Poly (Vinyl Chloride) (PVC) Plastic Drain, Waste, Vent Pipe, and Fittings

14. ASTM D2729 Specification for Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings

15. ASTM D2855 Practice for Making Solvent-Cemented Joints with Poly (Vinyl Chloride) (PVC) Pipe and Fittings

16. ASTM D3139 Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals

17. ASTM F477 Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe

C. American Water Works Association (AWWA):

1. ANSI/ AWWA C900 Standard for Polyvinyl Chloride (PVC) Pressure Pipe, 4 inch through 12 inch for Water Distribution

D. Sanitary Utility District Standards: Note that all work shall be performed and completed in accordance with the jurisdictional sanitary utility district's standard drawings and specifications.
The Contractor shall be responsible for obtaining all such standards and for compliance with such standards as applicable.

1.05 SUBMITTALS

A. Refer to Section 01 33 00 - Submittal Procedures, and Section 01 33 23 - Shop Drawings, Product Data, and Samples, for submittal requirements and procedures.

B. Submit Shop Drawings showing piping layouts, sizes, types, cleanouts, and the sewage structure ejector station.

C. Submit the respective manufacturers' product data for manufactured materials and equipment.

D. Submit equipment manufacturer's printed operating and maintenance instructions in accordance with Section 01 78 23 - Operation and Maintenance Data, consisting of a detailed parts list, a recommended spare parts list, and complete operation and maintenance procedures.

E. Submit certified test reports of equipment, as applicable.

1.06 SUBMITTALS FOR CLOSEOUT

A. Refer to Section 01 77 00 - Closeout Procedures, and Section 01 78 39 - Project Record Documents, for submittal requirements and procedures.

B. Record actual location of piping mains, valves, connections, thrust restraints, and invert elevations.

1.07 SITE CONDITIONS

A. Excavations shall be dry immediately before and after products are installed. Provide surfaces
and structures to, and on which sewerage products will be installed.

B. Coordinate the installation of the sanitary sewerage system with the jurisdictional sanitary
district or utility owner.

PART 2 - PRODUCTS

2.01 BURIED PIPE AND FITTINGS

A. Requirements: Provide the types, sizes, and configurations of pipe, fittings, and miscellaneous
materials and installation accessories as indicated and required. Pipe ends shall be bell and spigot, except plain end pipe shall be joined with mechanical clamp and gasket joint.

B. PVC Pipe and Fittings, 3 Inches and Smaller:

1. Pipe: Polyvinyl chloride (PVC), conforming with ASTM D1785, Schedule 40 or 80, as
indicated, Type I, Grade 1, bell and spigot style solvent sealed jointed.

2. Fittings: ASTM D2466, Socket Weld, same material and schedule as pipe.

3. Joints: Socket welded with PVC solvent cement conforming with ASTM D2564 and ASTM D2855.

C. PVC Pipe and Fittings, 4 Inches and Larger:

1. Pipe: AWWA C900, Class 200, Poly (Vinyl Chloride) (PVC) Water Pipe with Bell and Spigot Ends and Flexible Ring Joints.

2. Fittings: ASTM D2466, Type 1, Grade 1, Poly (Vinyl Chloride) (PVC) Fittings, Class 200.

3. Joints: ASTM D3139 gasketed bell joints with ASTM F477 gaskets.

D. Cast Iron Soil Pipe:

1. Pipe: ASTM A74.

2. Joint Devices: ASTM C564 or ANSI A21.11, rubber gasket joint devices, as applicable.

E. Clay Pipe:

1. Pipe: ASTM C700, unperforated.
2. Joint Device: ASTM C425, compression joint.

F. Concrete Pipe:

1. ASTM C14, Class 3, unreinforced.

2. Joint Device: ASTM C443, rubber compression gasket joint.

G. Reinforced Concrete Pipe:

1. Pipe: ASTM C76, Class III, with steel reinforcement.

2. Joint Device: ASTM C443, rubber compression gasket joint.

H. Pipe Accessories:

1. Pipe Joints: Mechanical clamp ring type, stainless steel expanding and contracting sleeve, with neoprene ribbed gasket for positive seal.

2. Fittings: Same material as pipe molded or formed to suit pipe size and end design, in required tee, bends, elbows, cleanouts, reducers traps, and other configurations as indicated or required.

I. Pipe Bedding Material: Clean sand as specified in Section 33 05 28 - Trenching and Backfilling for Utilities.

2.02 CLEANOUTS

A. At grade cleanouts shall have an adjustable sleeve-type housing, a threaded brass plug with countersunk slot, and cast iron frame and cover.

2.03 SEWAGE EJECTOR

A. Provide in accordance with applicable requirements of Section 22 14 29 - Sump Pumps.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify that trench cut excavation base is ready to receive work and that excavations, dimensions,
and elevations are as indicated.

3.02 PREPARATION

A. Excavations shall be free of water and extraneous material immediately before sanitary sewerage
products are installed or placed. Bottoms of trenches shall have a 6-inch sand bed and shall be formed to support the bottom quadrant of the pipe and fittings. Should rock be encountered or should bedding material be unsuitable to support the products at design elevation, continue excavation to an elevation 8 inches below the design elevation and backfill with clean sand.

B. Hand trim excavations to required elevation.

C. Remove large stones or other hard matter that could damage pipe or impede consistent backfilling and compacting operations.

D. Interior of pipe, pipe fittings, valves, drains, and cleanouts shall be cleaned of foreign substances
before installation.

3.03 INSTALLATION REQUIREMENTS

A. Excavate pipe trench in accordance with Section 33 05 28 - Trenching and Backfilling for Utilities. Hand-trim bottom of trench to approximately 6 inches below invert of pipe.

B. Top of pipe to finished grade shall be 30 inches unless otherwise indicated or approved by the Engineer.

C. Place sand bedding material meeting the requirements of Section 33 05 28 - Trenching and Backfilling for Utilities, at trench bottom, level in one continuous layer not exceeding 8 inches in compacted depth. Compact bedding to 95 percent relative density.

D. Backfill around sides and to 6 inches above pipe with cover fill tamped in place and compacted
to 95 percent relative density.

E. Test pipe distribution system and place tracer wire on top of pipe as specified herein prior to covering pipe. Backfill trench in accordance with Section 33 05 28 - Trenching and Backfilling for Utilities.

F. Maintain optimum moisture content of bedding material to attain required compaction density.

G. Install products where indicated. Remove and reinstall products that are disturbed after installation. Ends of products to which future connections will be made shall be either valved, or properly plugged, capped, and anchored.

H. Connections to existing facilities shall be made with fittings and short bends to suit the actual conditions. Connect products in accordance with the product manufacturer's installation instructions.

I. Pipe and fittings shall be set to line and grade before joints are made up. Angular deflections of
joints shall not exceed the recommendations of the pipe and fitting manufacturer. Should the alignment require deflection of joints to be in excess of those recommended, use special bends to achieve the indicated deflection. Pipe ends and joints shall be prepared in accordance with the manufacturer's recommendations. As a minimum, pipe ends shall be sanded and cleaned, fittings shall be cleaned, and solvent shall be applied to both pipe and fittings.

J. Install pipe, fittings, and accessories in accordance with ASTM C12, ASTM D2321, and the manufacturer’s instructions. Seal joints water tight.

K. Lay pipe to slope gradients as indicated.

L. Install bedding at sides and over top of pipe to minimum compacted thickness of 12 inches, compacted to 95 percent relative density.

3.04 INSTALLING PIPE

A. Protect pipe and fittings during handling to prevent damage.

B. Place, shape, and compact bedding material to receive barrel of pipe.

C. Start laying pipe at the lowest point; lay true to line and grade indicated.

D. Install pipe to bear on bedding material along its entire length.

E. Do not place the pipe on blocking material of any type.

F. Do not use wedges while installing the pipe.

G. Install pipe so that bells and grooves are on the upstream end.

H. Align each section of pipe with adjoining section leaving a uniform annular space between the bell and spigot to prevent sudden offsets in flow line.

I. As each section of pipe is laid, place sufficient bedding and backfill to hold it firmly in place.

J. Apply lubricant to rubber gasket (O-rings) immediately before joining pipe sections.

K. Keep interior of sewer clean as work progresses. Where small pipe sizes make cleaning difficult, keep a suitable swab and pulling line in the pipe, and pull through each joint immediately after jointing is completed.

L. Keep trenches and excavations dry and free of water during construction and until backfilling and compaction are completed.

M. When work is not in progress, securely plug ends of pipe and fittings to prevent extraneous matter from entering pipes and fittings.

N. Cut pipe ends, which project into a sewer structure, flush with the inside face of the structure and
cover exposed pipe reinforcement with grout.

O. Where length of stub is not indicated, install a 4-foot length, and seal the free end with brick masonry bulkhead or an approved stopper.

P. Obtain the Engineer's approval before covering pipe.

Q. Where indicated, place additional bedding material around and over the pipe in lifts not exceeding 6 inches before compaction. Compact each lift before placement of the next lift.

R. Accomplish compaction by methods that will avoid damage to pipe and will not disturb its alignment and grade. The use of vibratory rollers is prohibited until compacted cover over pipe has reached 3 feet or half the pipe diameter; whichever is greater.

S. Connect sanitary sewerage system to existing public sanitary sewers in accordance with requirements of the jurisdictional authority.

3.05 PIPE CLEANOUTS

A. Installation: Cleanouts shall be the same size as the pipe, with 4-inch diameter as a minimum. Cleanouts for drainage pipe shall consist of a longsweep 1/4 bend, or one or two 1/8 bends extended to the location indicated. Wall or accessible piping cleanouts shall be T-pattern, 90degree branch drainage fittings having screw plugs. Cleanouts shall be provided at the base of each riser and shall consist of a wye pattern fitting with a screw plug.

B. Form and place cast-in-place concrete pad with provision for sanitary sewer pipe ends.

C. Establish elevations and invert for inlets and outlets.

D. Mount cleanout surface hub level in grout to elevation indicated.

3.06 FIELD QUALITY CONTROL

A. Requirements:

1. Refer to Section 01 45 00 - Quality Control, for field inspection and testing requirements.

2. Where drainage piping is located below invert slabs, conduct a ball, shuttlecock, or mandrel test to ensure that the line is free of obstructions subsequent to the placing of pervious backfill material over the line and prior to the placement of the concrete invert slab.

3. Upon completion of the test and determination that the line is free of obstructions, plug,
cap, or otherwise close the open end or ends of the installed piping to prevent the entrance
of debris into the lines.

4. Immediately prior to final inspection of the work, remove debris from manholes, drain inlets, and floor scupper drains. In the presence of the jurisdictional sanitary utility owner's representative, prove by one of the methods specified above that the piping is free
of obstructions.

5. The Contractor shall be responsible for making all necessary arrangements with the jurisdictional sanitary utility owner for performing and witnessing the required tests.

6. Request inspection of exposed piping prior to placing backfill.

7. Compaction testing of related earthwork shall be performed in accordance with applicable requirements of Section 31 00 00 - Earthwork.

8. If tests indicate work does not meet requirements, remove such work, replace, and retest at no additional cost to the District.

B. Sanitary Pipeline Tests:

1. Perform air tests on all installed sanitary sewer pipes upon completion of backfill.

2. Hydrostatically test all installed sanitary sewer force mains.

3. Test all manholes for infiltration or exfiltration.

4. Test pipe sections by the exfiltration test.

5. Test sewer 24 inches or less in diameter with low pressure.

6. Sewers with a diameter greater than 24 inches may be tested by visual inspection.

C. Exfiltration Test:

1. Tightly plug end of pipe at downstream manhole.

2. Fill sewer, at either upstream manhole or standpipe, with water.

3. Allow water to stand for not less than eight hours, and until pipe has become saturated.
Refill manhole or pipe to measuring mark, and begin test.

4. Exfiltration will be determined as follows:

a. If standpipe has been filled, maintain a head of water not less than 2 feet nor more than 15 feet above highest point in the line being tested.

1) Exfiltration: that volume of water added to standpipe during a 20-hour period.

b. If upstream manhole has been filled, measure original water elevation and, after 20
hours, final water elevation. Convert difference in elevation to gallons. Head of
water shall be not less than 2 feet above highest point in the line being tested or not
less than 2 feet above existing groundwater table, whichever is greater.

1) Exfiltration: that volume of water calculated from the difference in elevations
during a 20-hour period.

5. Allowable leakage:

a. Not more than 200 gallons per 24 hours per diameter inch per mile of sewer.

b. If leakage exceeds permissible loss, sewer section will not be accepted.

c. Do not conduct another exfiltration test until conditions of groundwater surrounding pipe return to a condition similar to those existing at beginning of test period.

D. Infiltration Test:

1. Tightly plug end of pipe at upstream manhole.

2. Install a 90-degree notch weir in downstream manhole.

3. Allow water to accumulate behind weir until overflow is constant.

4. Allowable leakage:

a. Not more than 200 gallons per 24 hours per diameter inch per mile of sewer.

b. If measured infiltration is more than the allowable rate, sewer section will not be accepted.

E. Low-Pressure Air Test:

1. Clean and set sections of pipe to be tested before starting air test.

2. Plug pipe outlets with pneumatic plugs capable of resisting internal testing pressures without requiring external bracing.

3. Immediately following pipe cleaning and wetting, slowly supply air to plugged pipe until
internal air pressure reaches 4 psi. Allow at least two minutes for temperature to stabilize before proceeding, except slowly add air to maintain a 3.5 psig to 4 psig pressure. While temperature is stabilizing, spray plugs, pipes, and hoses with soap solution and eliminate air leaks.

4. After temperature has stabilized, measure time required for pressure to drop from 3.5 psig
to 2.5 psig. If measured time exceeds allowable time, pipe will not be accepted.

5. Time, in seconds, for pressure to drop from 3.5 to 2.5 psig shall be not less than the following; time for intermediate lengths shall be interpolated:

Length of Pipe Diameter In Inches

Pipe (Ft)	**8**	**10**	**12**	**15**	**18**	**21**	**24**
25	18	28	40	62	89	121	158
50	35	55	79	126	178	243	317
75	53	83	119	186	267	364	475
100	70	110	158	248	356	485	634
125	83	38	198	309	444	595	680
150	100	165	238	375	510	595	680
175	123	193	277	425	510	595	680
200	141	220	317	425	510	595	680
225	158	248	340	425	510	595	680
250	176	275	340	425	510	595	680

F. Visual Test Method: Slowly pull a television camera through sewer and inspect for visual leaks and cracks in pipe. Repair leaks, then re-inspect pipe.

G. Joint Pressure Testing:

1. Insert sealing packer with joint testing capability, into sewer line.

2. Place sealing packer around joint and pressure test joint. If a drop in air pressure occurs, reseal the joint.

3. Repeat procedure for each joint.

H. Criteria for Acceptance: The section of sewer being tested will not be accepted if test results exceed allowable leakage or take less time than minimum holding time. If pipe proves to be unacceptable, immediately repair defective materials and installation. The Contractor will not be permitted to change to another test if original test method reveals system has failed.

I. Obstruction Tests:

1. Perform field tests to verify that installed sanitary systems are free from obstructions.

2. Remove obstructions by excavating at the apparent obstruction and repairing or replacing the defective pipe.

END OF SECTION 33 31 00

SECTION 33 41 00 - STORM SEWAGE SYSTEMS

PART 1 - GENERAL

1.1 DESCRIPTION

A. This Section specifies the requirements for providing storm sewers and appurtenant structures.

1.2 QUALITY ASSURANCE

A. Reference Standards Applicable to this Section

1. AASHTO: American Association of State Highway and Transportation Officials

   a. M 36: Specification for Metallic (Zinc or Aluminum) Coated Corrugated Steel Culverts and Underdrains.

   b. M 190: Specification for Bituminous Coated Corrugated Metal Culvert Pipe and Pipe Arches.

   c. M 252: Specification for Corrugated Polyethylene Drainage Tubing.

   d. M 294: Specification for Corrugated Polyethylene Pipe 12 inch to 36 inch diameter.

2. ASTM: American Society for Testing and Materials

   a. A 48: Specification for Gray Iron Castings.

   b. A 74: Specification for Cast Iron Soil Pipe and Fittings.

   c. C 40: Test Method for Organic Impurities in Fine Aggregate for Concrete.

   d. C 76: Specification for Reinforced Concrete Culvert, Storm Drain and Sewer Pipe.

   e. C 150: Specification for Portland Cement.

   f. C 443: Joints for Circular Concrete Sewer and Culvert Pipe Using Rubber Gaskets.

   g. C 881: Specification for Epoxy-Resin-Base Bonding Systems for Concrete.

   h. D 618: Conditioning Plastics and Electrical Insulating Materials for Testing.

   i. D 1248: Polyethylene Plastics Molding and Extrusion Material.

   j. D 1693: Environmental Stress Cracking of Ethylene Plastics.

   k. D 1785: Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.

l. D 2239: Specification for Polyethylene (PE) Plastic Pipe (SIDR-PR) Based on Controlled Inside Diameter.

m. D 2412: Determination of External Loading Characteristics of Plastic Pipe by Parallel-Plate Loading.

o. D 2447: Specifications for Polyethylene (PE) Plastic Pipe, Schedules 40 and 80, Based on Outside Diameter.

p. D 2466: Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40.

q. D 2467: Socket Type Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.

r. D 2564: Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Pipe and Fittings.

s. D 2665: Poly (Vinyl Chloride) (PVC) Plastic Drain, Waste and Vent Pipe and Fittings.

t. D 2729: Specification for Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.

u. D 2855: Making Solvent-Cemented Joints with Poly (Vinyl Chloride) (PVC) Pipe and Fittings.

v. D 3035: Specifications for Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Controlled Outside Diameter.

w. D 3212: Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals.

x. D 3261: Specification for Butt Heat Fusion of Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing.

y. D 3350: Specification for Polyethylene Plastics Pipe and Fittings Material.

z. F 402: Safe Handling of Solvent Cements and Primers Used for Joining Thermoplastic Pipe and Fittings.

aa. F 405: Specification for Corrugated Polyethylene (PE) Tubing and Fittings.

bb. F 412: Standard Terminology Relating to Plastic Piping Systems.

cc. F 477: Elastomeric Seals (Gaskets) for Joining Plastic Pipe.

dd. F 656: Specification for Primers for Use in Solvent Cement Joints of Poly (Vinyl Chloride) (PVC) Pipes and Fittings.

ee. F 714: Specification for Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter.

ff. F 913: Standard Specification for Thermoplastic Elastomeric Seals (Gaskets) for Joining Plastic Pipe.

gg. F 667: Specification for Large Diameter Corrugated Polyethylene Tubing and Fittings.

3. Federal Specification

a. SS-S-210A and Latest Amendments: Sealing Compound, Preformed Plastic, for Expansion Joints and Pipe Joints.

4. City of Dickinson

a. Standard Construction Specifications for Wastewater Collection Systems, Water Lines, Storm Drainage and Street Paving, September 1996 or latest revision.

5. Galveston County Drainage District

a. Standard Specifications

b. Policy Criteria and Procedure Manual

1.3 SUBMITTALS

A. In accordance with Section 013300 – Submittal Procedures of these Specifications, the following shall be submitted:

1. Certificates

a. Manufacturer's certificates and load tickets stating that materials meet specified requirements.

2. Shop Drawings

a. Shop Drawings and details of all storm sewers and drains, including relationship to other systems and true position and details of all interfaces, connections, inlets, cleanouts, manholes, alignment and grade, changes of direction, offsets, bedding and protection, materials, manufacturer's installation and connection instructions and recommendations, and all other pertinent data.

PART 2 - PRODUCTS

2.1 GENERAL

A. Products for use within City of Dickinson, Galveston County or TxDOT right-of-way shall meet the applicable requirements.

2.2 PIPES AND FITTINGS

A. Reinforced Concrete Pipe (RCP)

1. ASTM C 76, bell-and-spigot, Class III, Wall B.

B. Corrugated Galvanized Metal Pipe (CGMP)

1. AASHTO M 36, coated and paved in accordance with AASHTO M 190, Type C coating for pipe and Type A coating for coupling bands.

C. PVC Pipe in accordance with the following:

1. ASTM D 1785.
2. ASTM D 2241.
3. ASTM D 2466.
4. ASTM D 2467.

D. PE Pipe

1. ASTM D 2447.
2. ASTM D 3035.
3. ASTM D 3350 Type PE 3408.
4. ASTM F 714 Type PE 3408.

2.3 JOINTS

A. Gaskets for RCP in accordance with the following:

1. Federal Specification SS-S-210A.
2. ASTM C 443.

B. All joints in PVC plastic pipe shall be solvent-cemented in accordance with the following:

1. ASTM D 2564.
2. ASTM D 2672.
3. ASTM D 2855.
4. ASTM F 402.
5. ASTM F 656.

C. All joints in PE plastic pipe shall be fusion butt-welded in accordance with ASTM 3261.

2.4 DRAINAGE STRUCTURES

A. Manhole

Type as indicated on the Drawings and conforming to applicable Standards for City of Dickinson or Galveston County Right-of-Way, or Galveston County Property. Frame and Cover ASTM A 48 Class 35 B.

B. Inlet

Type as indicated on the Drawings and conforming to applicable Standards in City of Dickinson or Galveston County Right-of-Way, or Galveston County Property. Frame and Grate ASTM A 48 Class 35 B.

C. Reinforcing Steel

As specified in Section 032100 - Concrete Reinforcement of these Specifications.

D. Cast-in-Place Concrete (Class 3000)

As specified in Section 321373.19 - Cast-in-Place Concrete of these Specifications.

E. Mortar (Type M)

2. 5 CEMENT-STABILIZED SAND BACKFILL

A. Aggregate

Use clean sand; deleterious materials in the sand shall not exceed the following limitations, by weight:

Material removed by denatation	5.0 percent
Clay lumps	0.5 percent
Other deleterious substances such as coal, shale, coated grains of soft flaky particles.	2.0 percent

Gradation Requirements:

Retained on 3/8-in. sieve	0 percent
Retained on 1/4-in. sieve	0 - 5 percent
Retained on 20-mesh sieve	15 - 50 percent
Retained on 100-mesh sieve	80 - 100 percent

Color test per ASTM C 40, color not darker than standard color.

B. Cement

ASTM C 150, Type I or II.

C. Water

Potable, from municipal supplies approved by the State or City Health Department.

D. Mixture

Use at least 1-1/2 sacks of cement per cubic yard of mixture. Use amount of water required to provide mix suitable for mechanical hand tamping and mix in approved mixer. Stamp load tickets at plant with time of loading. Material not in place within 1-1/2 hours after loading or that has obtained an initial set will be rejected and shall be removed from the Site and replaced with new acceptable mixtures at no additional cost to Lone Star College.

2.6 TIMBER POSTS

A. Southern Pine or Douglas Fir, pressure-treated in accordance with American Wood Preservers' Association (AWPA) Standards.

PART 3 - EXECUTION

3.1 GENERAL

A. All storm sewer work performed within City of Dickinson right-of-way shall meet the applicable requirements.

3.2 EXCAVATION

A. All excavation shall be in accordance with Section 017330 - Trench Safety Systems of these Specifications.

B. Perform excavation for storm sewer and storm sewer drainage structures to line and grade required as shown on the Drawings and as specified herein.

C. If the excavation exceeds the permissible dimensions, extend the encasement or install pipe of higher strength, as directed.

D. Prevent surface or ground water from flowing into excavation. Install, operate, and maintain dewatering system to convey water away from excavation. Notify the Engineer in writing of delays to the Work caused by water intrusion.

3.3 PIPE ENCASEMENT

A. Place cement-stabilized sand bedding before laying pipe. Bedding shall be compacted and shaped to fully support the pipe.

B. After the pipe is laid, place cement-stabilized sand beside and above the pipe in 4 in. lifts to the limits shown on the construction drawings. Compact individual lifts with a hand-operated, motorized tamper; exercise care to avoid damaging the pipe.

3.4 LAYING PIPE

A. Install and joint pipe in accordance with the pipe manufacturer's instructions and as specified herein.

B. Provide a minimum of 6 in. clearance between storm sewer and sanitary sewer.

C. Seal open end of pipe with plug when pipe laying operation is temporarily halted. Plug shall remain in place until operation restarts.

3.5 BACKFILL

A. On completion of construction, backfill the excavation as specified in Section 312300 – Excavation, Grading, and Fill of these Specifications and in accordance with details on the construction drawings. Backfill only when the written approval of the Engineer is obtained to do so.

3.6 CONSTRUCTION OF MANHOLES AND INLETS

A. General

1. Construct manholes and inlets as soon as practical after sewer lines into or through the manhole or inlet locations are completed.

2. Construct manholes and inlets at locations and of the type indicated. All manholes within 9 feet of existing water lines shall be watertight.

B. Manholes

1. Provide base of the shape and size required with a minimum thickness of 12 inches.

2. Place axis of manholes directly over the centerlines of the lines, unless otherwise indicated.

3. Shall be constructed of either precast or cast-in-place concrete.

C. Inlets

1. Shall be constructed of either precast or cast-in-place concrete.

3.7 CLEANUP

A. Remove temporary structures, rubbish, waste materials, and excess excavated materials from the Site and dispose of legally.

END OF SECTION 33 41 00